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UTILIZATION OF ACUTE CARE HOSPITAL PEDIATRIC SERVICES IN ALBERTA

by

© CAROL SMITH ROMERIL

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE
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Date. April 5, 1984 ....

ABSTRACT

Over the past two decades, social, and technological changes have impacted the field of acute pediatric care such that it now serves a smaller proportion of the population, encounters more complex cases, supports more highly trained pediatric specialists and tends to hospitalize children less often. The health service sector, challenged to respond to such changes, requires the support of an information base regarding the pediatric population and its patterns of utilization. These planning information needs constituted the impetus for this study.

The data bases from which the pediatric-specific information was derived consisted of all PAS separation abstracts generated by Alberta acute care hospitals from 1971 through 1980/81, Alberta hospital Annual Returns for the same period, and census data for 1971, 1976 and 1981. The methodological strategy was to undertake a descriptive investigation of pediatric per-capita utilization patterns in Alberta, over time, while differentiating levels of utilization relative to intensity/complexity through the use of levels of care categories. Several analytical methods were employed to examine pediatric utilization from provincial, district, and regional levels of aggregation. Patterns of patient movement were examined from both community-based and provider-based perspectives. Finally, patient movement patterns were used to estimate the proportion of utilization which could be attributed to tertiary level care.

The salient results of this descriptive investigation include:

1) Pediatric utilization rates of Alberta hospital services declined substantially between 1971 and 1980/81. (Patient-day rates dropped by more than 40%).
2) Areas with a full spectrum of service (tertiary, secondary and primary care) experienced lower utilization rates than did areas with partial spectrum services.
3) Patient movements tended to establish a natural pattern of regionalization for acute pediatric care which was becoming more pronounced over time.
4) Children from the Grande Prairie region were nearly as likely to receive pediatric care outside their home region as they were to receive care in the Grande Prairie region.
5) Based on commitment indices, it appeared that the University Hospital in Edmonton and the Foothills Hospital in Calgary functioned as the major pediatric tertiary referral centers in Alberta. The Alberta Children's Hospital did not manifest similar referral center characteristics during the study period.

6) For 1980/81, approximately 45,000 (15%) of pediatric patient-days were attributed to tertiary level care. Assuming 85% occupancy, these days were estimated to "require" 145 tertiary care pediatric beds in Alberta.

Results of this investigation were entirely descriptive and were relevant only to the 1971 - 1980/81 time period. On the basis of these results, recommendations for policy considerations and further research were offered.

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TABLE OF CONTENTS

CHAPTER PAGE

I INTRODUCTION 1

1.1 Nature of the Problem 1
1.2 Purpose and Objectives 4
1.3 Significance of the Study 5
1.4 Assumptions and Limitations 7
  1.4.1 Assumptions 8
  1.4.2 Limitations 9
1.5 Definition of Terms 10
1.6 Format of the Thesis 12

II A SELECTIVE REVIEW OF THE LITERATURE 13

2.1 Conceptual Framework 13
  2.1.1 Need 17
  2.1.2 Demand 18
  2.1.3 Supply 20
  2.1.4 Environment 22
  2.1.5 Utilization 23
2.2 Determinants and Patterns of Utilization 24
  2.2.1 Determinants of Need 25
  2.2.2 Determinants of Demand 32
  2.2.3 Determinants of Supply 39
  2.2.4 Summary 46
2.3 Classification Systems 47
  2.3.1 Disease Classification 47
  2.3.2 Patient Classification 52
  2.3.3 Hospital Classification 56
  2.3.4 Summary 62
2.4 Patient Origin-Destination Studies 63
  2.4.1 Patient Movement and Flow Patterns 65
  2.4.2 Delineation of Service Areas and Service Populations 70
  2.4.3 Comparative Perspectives of Resource Utilization 78
  2.4.4 Summary 83
2.5 Chapter Summary 84

CHAPTER PAGE

III METHODOLOGY 87

3.1 Investigational Strategy 88
3.2 Data File Development 94
3.2.1 Census Data 96
3.2.2 Professional Activities Studies (PAS) Data 99
3.2.3 Provincial Annual Reports 106
3.3 Analytical Steps 107
3.3.1 Provincial Analysis 108
3.3.2 District Analysis 109
3.3.3 Regional Analysis 111
3.3.4 Patient Origin-Destination Analysis 119
3.3.5 Levels of Care Analysis 127
3.4 Chapter Summary 131

IV RESULTS 134

4.1 Alberta Health Care System 134
4.2 Provincial Pediatric Utilization Trends 143
4.2.1 Utilization for All Diagnoses Combined 144
4.2.2 Utilization by Diagnostic Specific Categories 148
4.2.3 Summary 161
4.3 District Pediatric Utilization Rates 163
4.4 Regional Variations in Pediatric Utilization Rates 172
4.4.1 Rates for all Diagnoses Combined 174
4.4.2 Rates by Diagnostic Specific Categories 182
4.4.3 Summary 192
4.5 Patient Origin-Destination Studies 195
4.5.1 District Perspective Analyses 196
4.5.2 Hospital Perspective Analyses 210
4.5.3 Summary 230
4.6 Pediatric Utilization by Levels of Care 233
4.7 Chapter Summary 242

CHAPTER PAGE

V SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS 246

5.1 Summary 246
5.2 Findings 249
5.3 Conclusions 253
5.4 Recommendations 257

SELECTED REFERENCES 261

APPENDIX A Population Adjustments 275
A.1 Weighted Sum Method for Age-Sex Adjustments 276
A.2 Table of Age-Sex Adjusting Weights 278
A.3 Procedure for Exponential Population Projections 279

APPENDIX B Disease Codes and Diagnostic Categories 280
B.1 Detailed Listing of Diagnostic Category Codes 281
B.2 Diagnostic Category Titles and Abbreviations 283

APPENDIX C Formulae for Relevance and Commitment Indices 284

APPENDIX D Supplementary Tables for Diagnostic Specific Regional Analyses of Pediatric Utilization Rates 286

APPENDIX E List of Titles and Abbreviations for Regional Analyses 298

APPENDIX F Supplementary Tables for Patient Origin-Destination Studies for Geographic Regions 300

APPENDIX G List of Hospital Names and Abbreviations 306

APPENDIX H Tables of Estimates of Tertiary Bed Requirements by Varying Occupancy Rates 303

LIST OF TABLES

Table	Description	Page
1	Alberta Pediatric Population and Percent Change by Age Group for Census Years 1971, 1976, and 1981	140
2	Ratios of District Service Populations for 1971, 1976, and 1980	142
3	Comparison of Albertan and Canadian Indicators of Hospital Utilization for the Total Population and the Pediatric Population from 1971 to 1978	147
4	Separation Rates per 1000 Children-Year from 1971 through 1980/81 for Selected Diagnostic Categories	152
5	Patient-day Rates per 1000 Children-Year from 1971 through 1980/81 for Selected Diagnostic Categories	154
6	Average Length of Stay from 1971 through 1980/81 for Selected Diagnostic Categories	155
7	Comparison of Albertan and Canadian Pediatric Utilization of Hospitals in 1978 for Selected Diagnostic Categories	157
8	Comparison of Albertan and American Pediatric Utilization of Hospitals in 1979 for Selected Diagnostic Categories	159
9	Distribution Summary of District Separation Rates for 1971 - 1980/81	165
10	Distribution Summary of District Patient-day Rates for 1971 - 1980/81	167

Table	Description	Page
11	Patient-day Rates for Aggregated Regional Areas in Alberta	175
12	Separation Rates for Aggregated Regional Areas in Alberta	176
13	Average Length of Stay for Aggregated Regional Areas in Alberta	177
14	Relevance Indices to Patient's Own District Hospital(s) by Composite Diagnostic Category and Hospital Size	197
15	Relevance Indices of Area Patients to Their Own and Other Area Hospitals by Composite Diagnostic Categories	199
16	Relevance Indices (Patient-days) for Area Patients to Their Own and Other Area Hospitals for Selected Years	203
17	Relevance Indices (Separations) and Average Lengths of Stay for Regional Patients in Their Own and Other Regional Hospitals	206
18	Relevance Indices (Separations) and Average Lengths of Stay for Regional Patients in their Own and Other Regional Hospitals by Composite Diagnostic Category	207
19	Commitment Indices of Edmonton Hospitals to Residents of Selected Areas and Average Lengths of Stay	211
20	Commitment Indices by Edmonton Hospitals to Residents of Selected Areas and Average Lengths of Stay by Composite Diagnostic Categories	212

Table	Description	Page
21	Commitment Indices of Calgary Hospitals to Residents of Selected Areas and Average Lengths of Stay	216
22	Commitment Indices of Hospitals, by Differing Levels of Care, to Area Residents and Average Lengths of Stay	219
23	Commitment Indices (Patient-days) of Hospitals, by Differing Levels of Care, to Area Residents for Selected Years	222
24	Commitment Indices of Hospitals, by Differing Levels of Care, to Area Residents and Average Lengths of Stay for Composite Diagnostic Categories	223
25	Commitment Indices of Regional Hospitals to Their Own and Other Regional Residents	226
26	Commitment Indices of Regional Hospitals to Their Own and Other Regional Residents for Composite Diagnostic Categories	229
27	Total Patient-days by Area of Patient Origin and Destination for 1971 through 1980/81	235
28	Patient-days and utilization Rates for Three Levels of Care by Area of Patient Origin for 1971 Through 1980/81	237
29	Total Patient-days by Area of Patient Origin and Destination for 1980/81	239
30	Patient Days and Utilization Rates for Three Levels of Care by Area of Patient Origin for 1980/81	240

LIST OF FIGURES

Figure		Page
1	Conceptual Model of Health Services Utilization Applicable to Pediatric Services	15
2	Diagrams of Four District Aggregations	112
3	Separation Rate per 1000 Children-Year for all Diagnoses Combined by Year	146
4	Level of District DAY Rates for All Diagnoses Combined and for All Years Combined	171

CHAPTER I

INTRODUCTION

The Canadian health care delivery system is being challenged to respond to rapid medical and technological advances, altering patterns of utilization, and increasing financial constraints. Within this milieu of change, farsighted planning is needed to guide the evolution of the system toward a configuration which engenders effective and efficient provision of health services. Such planning requires information regarding the current system of delivery so that the new and developing modes of service can be rationally integrated into the system at large.

Many facets of the health care delivery system are undergoing evolutionary changes and are therefore having to plan responses to these transformations. One facet of particular interest to many Albertans is that of pediatric care. The pediatric sector, as with any other health care sector undergoing metamorphosis, therefore, requires an information base from which to launch its plans for response to that change. In response to this need, an examination of selected aspects of pediatric services and utilization patterns, for the time period from 1971 to 1981, was undertaken.

1.1 Nature of the Problem

There have been a number of social and medical changes over the last two decades which have influenced patterns of pediatric service delivery and utilization. Such transformations included changes in the population structure, changing patterns of pediatric morbidity and changing patterns of pediatric practice (Pless, 1974). With regard to the population, the children of the "baby boom" in the nineteen fifties and early sixties were older and passing beyond the "pediatric" age groups. By 1976 for example, the widest section of the Canadian population "pyramid" was at the 15 to 19 year age group (Ouellet, 1979). With regard to pediatric morbidity, communicable diseases were coming under better control (Robinson and Clarke, 1980), likely due to school health and immunization programs. On the other hand, medical and technological advances began to increase survival of otherwise fatal conditions, giving rise to newly recognized aspects of morbidity in areas such as neonatology and congenital anomalies. With regard to patterns of practice, the increasing specialization of medicine had extended into the field of pediatrics such that pediatric surgeons, pediatric anesthetists, and similar subspecialists began to develop areas of expertise. In addition, patterns of practice were changing in response to increasing concern regarding the apparent mental and emotional trauma experienced by children being hospitalized (Shore, 1965). As a result, efforts were made to limit hospitalization trauma by shortening hospital stays, avoiding unnecessary admissions and designing child centered environments for hospitalization (Bongiovanni, 1963;

Robinson and Clarke, 1980).

In a capsule, it appeared that in the early nineteen eighties, as compared to the early sixties, the field of pediatric acute care served a smaller proportion of the population, encountered more complex cases, supported more highly trained pediatric specialists and subspecialists, tended to hospitalize children less often, and tended to be more concerned for the mental health of hospitalized children. Given these changes, a movement for the assessment and reorganization of health service delivery for children has gained public recognition and appeal across the country as well as in Alberta.

With respect to Alberta, the Alberta Children's Hospital in Calgary has recently consolidated pediatric services, to some extent, in that city and has expanded services to offer a range of ambulatory services and psychosocial support services. In Edmonton, the Northern Alberta Children's Hospital Foundation is supporting and encouraging the concept of centralizing pediatric services in a specialized facility. The Foundation feels that such a facility would attract highly trained personnel and provide a needed tertiary referral and teaching center for pediatrics (Bain, 1979; Duncan and McCoy, 1979).

Assessments of current service delivery and proposals for service reorganization both require the support of substantial information bases so that rational comparisons and decisions can be made. With regard to pediatric services, volumes of utilization data were available but they had not been analyzed or organized into a comprehensible information base. Information which would be necessary in planning for a possible reorganization of pediatric services would include: 1) a profile of the Alberta pediatric population and its disease experience, 2) patterns of hospital use and trends in utilization over time, 3) variations in patterns of use among regions and demographically disparate areas, 4) patterns of referral and patient movement across regions, and 5) varying intensity of use or need as implied by levels of care. These planning information needs constituted the impetus for this investigation. The information needs were viewed from a methodological perspective. Consequently, an exploratory analysis of pediatric utilization data was undertaken to translate the data, through descriptive statistics, into meaningful information.

1.2 Purpose and Objectives

The purpose of this investigation was to explore patterns of utilization of acute hospital pediatric services in Alberta, with particular emphasis on patterns of use relative to levels of care, so as to develop an information base for planning the future of pediatric services in Alberta. The information base was founded on a ten year, 1971 to 1981, longitudinal analysis of pediatric utilization data and age-sex adjusted population data. In order to develop information which would be valuable to the planning process, the following objectives were established:

1. To identify the level of acute care hospital service utilization by the Alberta pediatric population, and its sub-populations, and associated trends in utilization over a ten year period.
2. To identify and compare district and regional utilization rates over time from a "community-based" perspective.
3. To identify patterns of patient movement from both community-based and provider-based perspectives. From the latter perspective patterns of use relative to specific hospitals or hospital groups would be determined.
4. To identify and compare disease specific patterns of utilization with a view toward developing comparisons of utilization by levels of care based on diagnostic groupings.
5. To estimate the extent of pediatric service utilization in Alberta, which could be classified as tertiary level care.

1.3 Significance of the Study

Issues related to pediatric services can often be distorted by the emotionalism and enormous public pressure generated by various interest groups which tout the altruism of care for sick children. Rational discussion of the issues then tends to become clouded and the situation becomes politically sensitive. Given such a scenario, a well documented information base is a prerequisite for rational decision making. The inherent value of the information base in decision support is dependent upon the degree to which it can operate as the objective balance to subjectively weighted social, political and economic factors.

A sound information base is also valuable in its potential role as a baseline from which to forecast future resource needs. The planning process for resource allocations, for example, is judiciously begun by examining past patterns of use and apparent need. Direct examination of need would of course be most valuable and desirable. Yet, without clear definitions and valid measures of need, information regarding utilization provides the closest approximation.

This study is also considered significant from a methodological perspective. Actual utilization patterns for one specialty service--pediatrics--are to be quantitatively analysed. Such specialty specific analyses are recognized by several authors as a valuable step toward understanding the components of composite utilization patterns (Studnicki, 1975b; Toll, 1982). The use of population-based measures to calculate per capita pediatric utilization rates enables meaningful comparisons among districts and regions within Alberta. Patient origin-destination analyses will bring to bear a variety of utilization determinants such as patient preferences, geographical factors, and physician referral patterns, which are not easily examined or accounted for through other analyses. Finally, the estimation of tertiary care needs contributes an added dimension to the traditional analyses of utilization patterns. The added dimension is the recognition that utilization of hospital resources occurs at varying levels of intensity which are relevant to planning the provision of service.

To the author's knowledge, this type of investigation has not been conducted for pediatric acute hospital services. The investigation could however be considered a composite of previous work in utilization in that it draws experience from other studies (Paine & Wilson, 1975; Raasok, 1979, MacDonald, 1982, Toll, 1982) to apply to pediatrics. For this investigation the combination of quantitative and qualitative analyses of past utilization patterns was intended to aid in: 1) assessment of feasibility of regionalizing pediatric services, and 2) planning for cost-effective and efficient allocation of resources, particularly those for tertiary care.

1.4 Assumptions and Limitations

This section outlines the assumptions and limitations which provide the groundrules and boundaries for this investigation.

1.4.1 Assumptions

The following assumptions are prerequisite to the study methodology.

1. The Alberta health care system functions as a "closed system." This assumption connotes the exclusion of Alberta residents who were admitted to non-Alberta hospitals and non-Alberta residents who were admitted to Alberta hospitals. The secondary assumption is that the above exclusions would have little impact on the overall patterns of utilization.

2. The study areas can be meaningfully divided into mutually exclusive and exhaustive geographic areas. The existing general hospital districts (GHDs) are appropriate to such geographic divisions. In addition, GHDs can be aggregated into larger regions which are consistent with patient movement and referral patterns.

3. It is possible to differentiate between three levels of care, each representing a relative degree of complexity and intensity of service. The levels of care, primary, secondary and tertiary, are successively inclusive such that tertiary care, the most complex and intense level of care, also subsumes primary and secondary care.

4. The basic needs of the service population, within each level of care (primary, secondary, and tertiary), are approximately equivalent.

5. The tertiary level of care, characterized by high concentrations of technology and specialized personnel,

are very resource intensive and therefore have great implications for resource allocation planning.

1.4.2 Limitations

The limitations listed below are the methodological and data related restraints associated with this investigation.

1. The pediatric utilization data and census data were obtained from government sources. Verification of data reliability and validity was therefore not possible. However, because these data were routinely subjected to quality control checks, this limitation was not considered to be of major consequence.
2. Compilation of the utilization data is a complex and voluminous task. Consequently, the most recent data available were over two years old.
3. By virtue of using Professional Activities Study (PAS) data, the number of individual patients cannot be identified. Instead, the unit of analysis is separation episode. Patients with repeated admission-discharge episodes could therefore inflate the number of separations above the number of actual patients.
4. Location of patient origin was coded by PAS according to hospital district. The PAS definition of district patient origin, rather than a point location of origin, was therefore adopted for this investigation.

5. The scope of this investigation did not demand an exhaustive examination of all diagnostic categories which described pediatric morbidity. Sixteen specific categories were selected, based on relatively subjective criteria, for detailed examination.

6. The ten year time span of data limited the homogeniety of some diagnostic categories over time in that the diagnostic coding system was revised twice during the ten year period.

7. Population data were available only for the census years 1971, 1976 and 1981. Consequently, population estimates had to be used for interim years.

8. Analyses were exclusively oriented to descriptive statistics and as such, were only expected to demonstrate associations, not to provide evidence for causal inferences.

9. The investigation was limited to providing information regarding past pediatric utilization. Because there was no basis from which to evaluate utilization, no assessment was attempted with respect to the appropriateness of the level of pediatric utilization.

1.5 Definition of Terms

The following definitions provide clarification for terms used in this investigation.

1. Acute Pediatric Services: refers to both diagnostic and treatment endeavors involving hospital inpatients who

are under 15 years of age, excluding newborns. Services rendered to pediatric outpatients are not included.

2. Average Length of Stay (ALOS): is the average number of days accumulated by pediatric patients who were separated from the facilities under study during a specified time period. It is calculated by dividing total pediatric patient days by the number of pediatric separations for a specific time period.

3. Levels of Care: are conceptual categories which represent relative degrees of intensity/complexity in the service and care of inpatients. The terms primary, secondary and tertiary are used to denote three relative levels of service or care. When applied to diseases the three categories represent varying levels of care typically required for a given disease. Primary level care requires the provision of a large number of basic services; tertiary care requires uncommon and highly specialized services while secondary care requires more than basic services but not highly specialized services. When these descriptive categories are applied to hospitals, they represent varying levels of service which a hospital is equipped and staffed to provide (Toll, 1982, pp. 12-13).

4. Patient Days (DAYS): are the total number of days spent in hospital by pediatric in-patients during a specified time period.

5. Patient Destination: is the acute care hospital to which a pediatric patient is admitted.

6. Patient Origin: is the hospital district in which the pediatric patient resides.

7. Pediatric Population: refers to all children under the age of fifteen as determined by a federal census or as estimated by intercensal year interpolation.

8. Separation (SEP): is the discharge or death of a pediatric inpatient.

9. Service Population: refers to the age-sex adjusted census population of a particular area. Provincial or hospital district service populations are equivalent to the age-sex adjusted census populations for the province or the hospital district respectively. However, the term is used somewhat differently when it is applied to hospital service populations. In this case the service population is not associated with a specific geographic area but represents an age-sex adjusted "population" or number of persons which could be described as potential users of the hospital under study.

1.6 Format of the Thesis

The text of this thesis has been divided into five chapters. The preceding introduction constitutes Chapter I. The foundation for the investigation is developed through a selective review of the literature which is contained in Chapter II. Chapters III and IV provide the methodology and the discussion of data analyses respectively. A summary, a synopsis of major findings, and resulting conclusions are presented in Chapter V.

CHAPTER II

A SELECTIVE REVIEW OF THE LITERATURE

The purpose of the literature review is to provide a contextual foundation for the research objectives and to describe the theoretical antecedents of the research methodology. The review is divided into five components: 1) a description of the conceptual model of pediatric utilization developed for this investigation, 2) a presentation and discussion of determinants of utilization and pediatric utilization in particular, 3) a presentation and discussion of classification methods and their applications, 4) a review of patient origin-destination studies, and 5) a summary.

2.1 Conceptual Framework

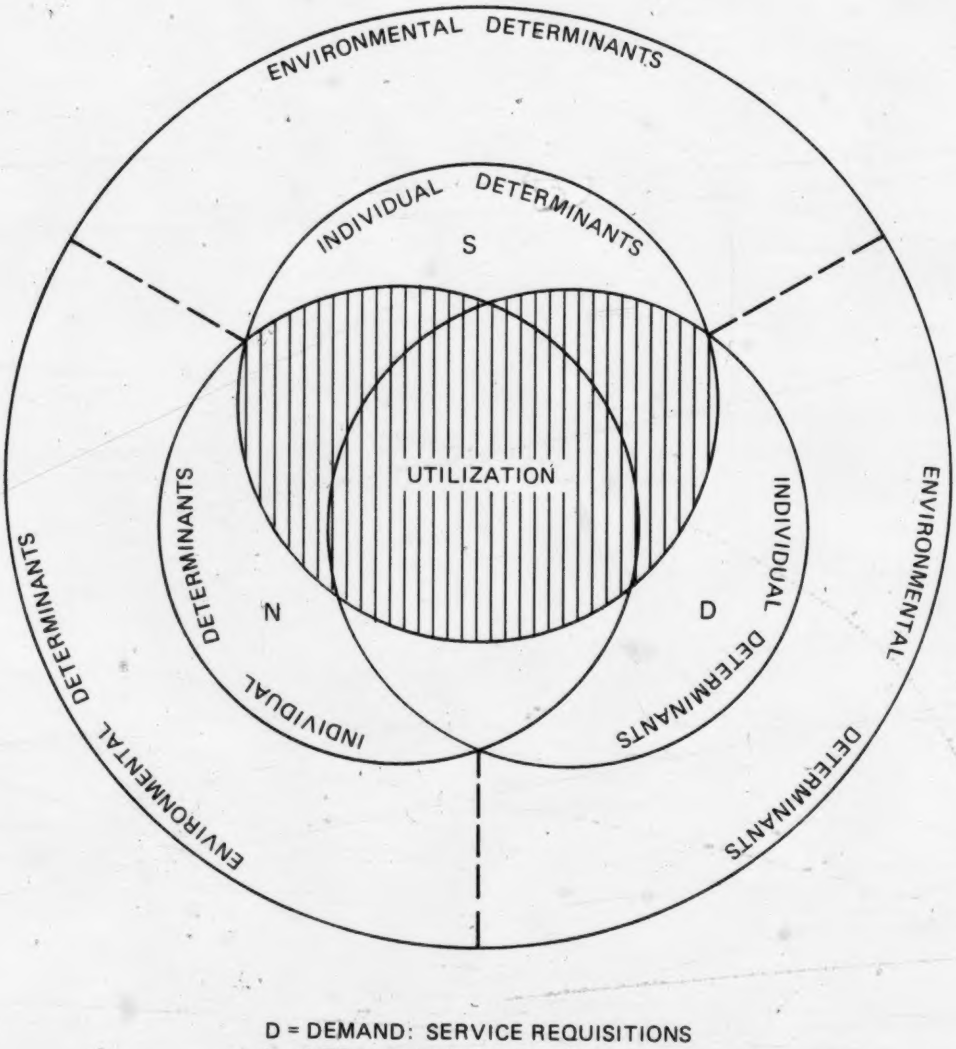
Most issues can be viewed from a variety of perspectives. In the case of a research question, a delineated perspective from which to view the problem is a fundamental step in the attempt to investigate the question and interpret the related findings. The utilization of pediatric services has been investigated from various perspectives but none has become a commonly accepted theory of, or approach to pediatric utilization. Congruent with the process of theory evolution, the literature still seems to be focused on the development and linkage of concepts into models. Unfortunately, none of the models were expressly developed for pediatric utilization.

A conceptual model was therefore developed for the purposes of this investigation. It was intended to conform to Churchman's idea of dynamic systems (Churchman, 1968). It is a generic type model, a synthesis of other models relevant to hospital use in general. In its generic form it can be applied to service specialties, including pediatrics. The transferability of the model from generic to specific areas of utilization was based on the assumption that the fundamental concepts of utilization and their linkages were universal; while it was the determinants of specific utilization patterns and their relative influences which "specialized" the model. The model which was developed was intended to be useful in: 1) providing an overall system perspective, 2) illustrating various relationships within the system, 3) providing a framework with which to organize existing information and literature, and 4) providing a basis with which to interpret findings.

The model was developed from many sources but was most heavily influenced by the work of Jeffers, Bognanno and Bartlett (1971), which offered a consumer market perspective of utilization; and of Andersen and Newman (1973) which suggested a social systems type perspective of utilization. The composite model for this investigation consequently included the major conceptual factors of need, demand, supply, environment and their intersection, utilization (see Figure 1).

FIGURE 1

CONCEPTUAL MODEL OF HEALTH SERVICES UTILIZATION APPLICABLE TO PEDIATRIC SERVICES



D = DEMAND: SERVICE REQUISITIONS
N = NEED: PRESENCE OF DISEASE
S = SUPPLY: ACCESSIBLE RESOURCES

In essence the model recognizes two levels of determinants, individual and environmental, each representing a level of research and thinking regarding utilization. For example, some studies focus on characteristics of the individual which influence utilization (Colle and Grossman, 1978) while others focus on aggregate population characteristics (Jeffers, Bognanno and Bartlett, 1971).

The individual level of determinants is divided into three components; determinants related to need, demand, and supply. Individual determinants of need relate to the presence of illness or disease and include such factors as vulnerability or susceptibility to disease, intensity of existing disease, and health status. Individual determinants of demand relate to requisitions for service and are influenced by such factors as concepts of and attitudes toward health, and family support resources. Individual determinants of supply relate to the accessibility of resources to the individual and are influenced by such factors as proximity of residence to care facility and ease and cost of transportation.

The environmental level of determinants is also divided into three components; determinants related to need, demand and supply. Environmental determinants of need include such factors of disease prevalence in the population and disease virulence. Environmental determinants of demand include such factors as social norms and social or community support systems. Environmental determinants of supply include such factors as the economic milieu, the political milieu, and the extent of diagnostic and treatment related technologies.

According to the model utilization then is a function of, or the intersection of, the interactive influences of need, demand and supply, both on an individual level and broader environmental level. The actual nature of interaction among need, demand and supply is however not understood and is therefore illustrated simply by the intersection of circles or spheres of relevance.

In the following sections, the major conceptual components of this model are discussed in relation to the literature.

2.1.1 Need

The concept of need has been defined and discussed in many ways. Many authors describe need for health services as the health services a physician, or other health professional, considers that a person or population ought to use (Arrow, 1963; Boulding, 1966; Feldstein, 1967; MacStravic, 1978; Soderstrom, 1978). Donabedian (1973) offers a moderated definition by suggesting need be considered as any disturbance in health and well-being, as perceived by either the individual or a health professional. Andersen and Newman (1973) seem to agree with Donabedian's view by recognizing two aspects of "illness level," one as perceived by the individual and the second as evaluated by a physician. Jeffers et al (1971) however, termed such patient perceptions as "wants."

Other authors tend to minimize the role of health professionals in determining need by arguing that need is actually socially defined in terms of relative, rather than absolute, socio-economic situations (Boulding, 1966; Field, 1973). Still other authors retreat from the concept of need in favor of the view that manifest demand for health services is a proxy for need (Maynard, 1979; Stone, 1980). Fuchs (1968) went so far as to argue that the concept of need was too imprecise to be of any analytical value. This may be true in the sense that need is too ambiguous for valid measurement but this should not negate the validity of the concept itself.

For purposes of this investigation, the operational definition of need for health service use is: the presence of illness or disease as determined by a health care professional. The use of the word disease in this operational definition should be interpreted liberally as to include altered states of well-being (Antonovsky, 1980). The role of the individual (or the parents) in recognizing need is not included in this definition. It can therefore be considered as a "medical" definition of need. The individual or parental role is instead seen as one of generating demand through "wants" for service.

2.1.2 Demand

Much of the literature on demand for health services is written by economic theorists (Arrow, 1963; Evans, 1974;

Grossman, 1979; Newhouse, 1975; Vertinsky & Uyeno, 1973). It is unlikely that the actual care-seeking behavior conforms to the laws of classic market economics due to major uncertainties, such as the stochastic nature of illness and the uninformed, or dependent, consumer, which are not accounted for in the well-defined economic model (Donabedian, 1973). However, the concept of demand is generally recognized in the literature as a component of utilization. The definitions of the concept however are as varied as those for need.

Demand has been described as being manifest when a person approaches the medical system requesting care (Boulding, 1966, Cooper, 1974). However, as with the concept of need, two perspectives emerge; one of patient generated demand and the other of physician generated demand (Stoddard & Barer, 1980). Feldstein (1967) recognizes the two perspectives by describing "initial" patient generated demand, and subsequent "derived" demand resulting from the physician's action. The central confusion regarding definitions of demand is that researchers have frequently failed to distinguish between demand and utilization (MacDonald, 1982). Feldstein (1967) for example equates demand and utilization, for purposes of analysis. The conceptual deficiency of equating utilization and demand is that unmet demand is ignored and overuse is unquestioned.

The confusion regarding the nature of demand is deepened by the use of demand as a proxy for need, as noted previously. Jeffers et al (1971) attempted to clarify this point by arguing that demand for medical services was a market behavior related to consumer "wants," rather than an identifiable, unique quantity of medical services. Need on the other hand, was an unique quantity of service which was related to biological and psychological health as perceived by expert medical opinion. The concepts of need and demand as described above, could not be equated or used interchangeably because of their inherently different nature; demand being a "functional market behavioral relationship" (Jeffers et al, 1971, p. 57) and need being an identifiable quantity of service.

The operational definition of demand for the conceptual model in Figure 1 is: health care services requisitioned by the patient, or the patient's parents. The role of the physician is excluded from this concept of demand, but is included in the overall model via the need concept.

2.1.3 Supply

Supply is another concept which is borrowed from classic market economics and as such, is the conceptual companion of demand. As with demand however, it is unlikely that supply influences utilization or consumer behavior, in accordance with the laws of classic economic supply (Arrow, 1963; Cullis & West, 1979). It is although, difficult to dispute that the level of service supply influences service utilization in some fashion (Soderstrom, 1978). Limited supply for example, could limit utilization. It is the mechanism and impact of supply on utilization which are not clearly understood.

The concept of supply relevant to the health system is often discussed in the literature in terms of, or in relation to, resource allocation and distribution, and the resulting effects on utilization (Anderson, 1976; Maynard, 1979; Office of Health Economics, 1979). Perhaps one of the most notable areas of discussion is that of hospital bed supply. Several researchers demonstrated that increased local bed supply was directly associated with increased local utilization (Anderson, 1973; Roemer, 1961a; Roemer, 1961b; Rosenthal, 1965). A debate then arose regarding the reason for this association; whether it was spurious in that some antecedent factor was causally related to both supply and utilization or whether the association between supply and utilization was causal. Harris (1975a & 1975b) addressed this issue by using path analysis to compare the alternative explanations. His research supported the causal, rather than the spurious, association.

For purposes of this investigation, and its conceptual model, supply is defined as the amount, type, and level of resources available and accessible to the patient. The term resources should be loosely interpreted to cover, health care personnel, facilities, beds, and related services. Such a broad definition was established so as to include resource allocation and distribution under the rubric of supply.

2.1.4 Environment

The concept of environment is included in the model to represent dimensions of influence on utilization which are beyond the level of the individual patient. It represents the physio-demographic, societal, political, economic, and organizational factors which influence need, demand, supply, and ultimately, utilization.

This second level of influence is discussed in the literature in terms of systemic or pervasive factors which affect not only the individual but the population as a whole. Andersen (1976) noted that some research examines characteristics of individual patients, with respect to utilization, while other research examines aggregate population characteristics. Andersen expands this aggregate perspective to develop a "social systems" model of hospital utilization which includes a set of social, demographic, and economic variables. Andersen and Newman (1973) also recognized the influence of aggregate factors on utilization by including "characteristics of the health services delivery system," in addition to "individual determinants of utilization," in their model. Similarly, Harris noted that hospitalization was a "social as well as a medical phenomenon" (Harris, 1975b, p. 229). Consequently, his model of utilization included aggregate characteristics such as a population's demographic and socioeconomic characteristics.

2.1.5 Utilization

Utilization is a function of need for health services, demand for health services, and supply of health service resources. This functional relationship is illustrated in the conceptual model as an intersection of need, demand, and supply. More precisely, utilization represents need and/or demand for health services which is met by the supply of available resources. The model therefore connotes and recognizes that not all needs or demands are met by corresponding resources. Some needs for service, such as scoliosis, may go unrecognized and therefore not supplied with appropriate care. These situations are represented by the portion of the need sphere which is not intersected by demand or supply. Correspondingly, demands which are unneeded in the medical sense and remain unsupplied, such as megavitamin therapy for example, are represented by the portion of the demand sphere which is not intersected by need or supply. In addition, the model represents surplus or idle supply by the unintersected portion of the supply sphere. This may be an important feature of a model which applies to pediatric utilization in that the declining pediatric population, and the decreasing tendency to admit children to hospital may have resulted in supply surpluses with respect to pediatric care resources such as pediatric beds.

2.2 Determinants and Patterns of Utilization

The literature regarding determinants of utilization is extremely varied. Authors approach similar variables from many different perspectives and reach a wide range of conclusions. The conceptual model, presented in the previous section, has therefore been used to categorize the literature into a cohesive format for discussion. It should be recognized however that not all the literature fits neatly into the category in which it is discussed. This arises primarily because the determinants are presented and discussed, for the sake of simplicity, as independent factors when, in fact, they are unlikely to operate independently. Unfortunately little is known about their interdependent relationships (Rosenthal, 1964, p. 8). A notable exception is the work of Ro (1973) which examines interaction effects of age, sex, and race. It is important to remember that utilization determinants are identified in the literature by virtue of an empirical association with utilization; not necessarily by a causal relationship.

The discussion of determinant factors is not intended to be exhaustive, rather it is intended to provide a representative cross-section of the literature regarding that factor. Literature which represents both the individual, and environmental levels of influence are presented. The discussion of each factor is generally initiated through literature which applies to utilization in general and then progresses to literature which is particularly applicable to pediatric utilization.

2.2.1 Determinants of Need

Determinants of need are those factors which influence the presence of, and severity of illness or disease. These can be divided into two broad categories: 1) environmental determinants which include the epidemiological and demographic characteristics of a population, and 2) individual determinants which include the individual's overall health status and susceptibility or vulnerability to disease.

Environmental Determinants

Health care needs of individuals can be influenced by many environmental factors such as climatic conditions, air pollution, and exposure to chemical toxins or radiation. Notable examples include the Great London Fog and the tragic Love Canal incident. In 1952, climatic factors and high levels of air pollution formed a thick London fog to which many deaths, from respiratory conditions, were attributed (Mausner & Bahn, 1974, p. 273). Meteorologic conditions such as changes in humidity are now considered as etiological factors in many cases of asthma, in children and adults. The Love Canal case came to public view through reports of unusually high rates of birth defects and illnesses within a specific area. This unusually high level of morbidity was later attributed to an old chemical waste dump situated under the community housing development (Maugh, 1979). Obviously, such factors are beyond the control or influence of the individual.

Other factors in the etiology of disease in an individual, and the subsequent health care needs, relate to patterns of disease within the population and the virulence of the disease itself. In the case of communicable diseases, the endemic level of the disease and the population's "herd immunity" are important factors in person-to-person spread of disease. Herd immunity is the resistance of a group to the spread of communicable disease due to the immunity of a high proportion of individual group members (Mausner & Bahn, 1974, p. 277). Thus, if the population or community is largely immune to the disease, the chances of a particular individual contracting the disease are greatly reduced. This has been the principle behind the recent vaccination campaigns for childhood diseases, and rubella in particular. Virulence of the disease in question is another factor in determining health care needs. An infection, for example, may be highly contagious and spread quickly throughout the community. However, unless the severity of the resulting illness is such that it requires medical attention, the illness has no apparent impact on health care needs (Mausner & Bahn, 1979). Severity of the illness and the resulting needs however are only partially determined by disease virulence. Needs are also a function of individual characteristics which influence the person's proclivity toward illness.

Individual Determinants

Demographic variables such as age, sex and ethnicity have traditionally been recognized as characteristics of an individual which are related to patterns of illness and hospital use. The health care literature is in fact, replete with research using demographic variables. Few studies, however, relate demographic variables to measures of need for health care, primarily due to the lack of adequate operational definitions of need. Much of the research therefore explores the relationship of demographic factors to measures of utilization. Despite the volume of research, or perhaps because of it, the role of the various individual characteristics in determining patterns and levels of utilization, remains unclear. Many of the research conclusions are contradictory.

Conflicting results have been attributed to the varied perspectives, strategies, models and variables which characterize this body of research (McKinlay, 1971). More specifically, conflicting results have been attributed to different perceptions of relevant factors and varying levels of complexity among the models. Newhouse (1975), for example, compared results from two models used to predict demand. One was a full scale, complex model while the other was a similar, yet simplified model, which omitted measures of health status, price of service and insurance coverage. The results were substantially different, he concluded, because the simplified model excluded factors of great influence. Similarly researchers seem to have largely overlooked potentially influential interaction effects of the variables under study (McKinlay, 1972). In addition, Andersen & Newman (1973) emphasized that different sets of determinants could be expected for varying types of service, purposes of service, and units of analysis. Unfortunately, the literature is often confused or silent in regard to these categorizations. Fundamentally different research bases, using different types of service (hospital and clinic) for example, could therefore explain some of the apparent disagreements regarding individual determinants.

Age is one variable on which most authors agree. Age is probably the best predictor, with the exception of the presence of illness, of hospital utilization (Andersen, 1975, p. 13). This is likely due to the strong association of age and morbidity. In general, increasing age is associated with increasing hospital utilization (Anderson, 1973; Rosenthal, 1965). In particular, lengths of stay tends to increase steadily with age (Aday & Eichhorn, 1972). Thus, length of stay and hospital admission rates tend to be lower for children than for any other age group (Anderson, 1973; White, 1968). Within the pediatric age group, age-specific utilization rates for children age 0 to 1 year are the highest while rates for children age 5 to 14 are the lowest (North, 1976; Bureau of Epidemiology, 1978). Confusion may arise through references to a U-shaped curve which describes the relationship between age and "utilization" (the very young and old people using more services than other age groups). Generally, this relationship is seen when physician visits are used as the measure of utilization (Aday & Eichhorn, 1972).

In the case of children, the physiological implications of youth can directly influence a child's susceptibility to disease and the intensity of disease (Apley, 1979). Very young children, for example, have immature immune systems which render them more vulnerable to communicable disease and infections. Similarly, the severity of gastrointestinal disorders, for example, could be exacerbated by disruption of the sensitive fluid and electrolyte balances in a small body (Gamble, 1947). These physiological implications of youth often connote special needs in terms of health services. In support, a nationwide study in the United States, comparing children's hospitals and general hospitals (hospitals were matched for size and geographic area), found that the hospital needs, and costs, of sick children differ significantly from those of hospitalized adults (Andersen Company et al, 1978). The survey found that children placed heavier burdens on hospital resources than did adults, particularly in terms of nursing care. Much of this difference was attributed to the finding that young patients were generally more ill than adults.

The role of sex as a determinant of health services need or utilization is largely a function of women's needs for obstetrical care. Hospital admission rates are higher for women than men. If however, obstetrical admissions are excluded, the difference is greatly reduced (Aday & Eichhorn, 1972). Thus, sex is not usually considered an important determinant of need or hospital use prior to childbearing age, which is usually considered to be 15 years.

Very little is written regarding sex as a determinant of pediatric morbidity or utilization. This is partly because physiological sex differences are not entirely manifest and partly due to the general paucity of literature regarding pediatric utilization. The silence on the subject should not however be interpreted to mean that male and female children have equivalent health care needs, or use hospital services equally. There are, for example, noticeable differences in sex-specific patterns of pediatric morbidity documented in statistical reports (Ouellet, 1979; Russel et al, 1980). Such differences however appear relatively small in relation to sex differences in morbidity patterns of older age groups (Ouellet, 1979).

Ethnicity has also been examined as a determinant of health care need and hospital use. With regard to health, Adebonjo (1973), found that ghetto children (predominantly black) were sick more often than the predominantly white suburban children and had more serious and life-threatening illnesses. In a comprehensive review and summary of the utilization literature, Aday & Eichhorn (1972) conclude that race predicts volume of service consumed and the site of the visit (independent of income differences). With regard to hospital utilization, admission rates were higher for whites than nonwhites although nonwhites generally had longer lengths of stay (Aday & Eichhorn, 1972). The longer lengths of stay are consistent with Adebonjo's (1973) finding cited above.

In British Columbia, Robinson and Evans (1973) found that hospital admissions for native children (ages 1 to 14) were three to four times higher than admissions for non-native children. In addition, native children had longer lengths of stay and were admitted more often for medical diagnoses. This study is, however, methodologically weak, and thus the results should be considered as preliminary.

Several authors have cautioned that the variable race is easily confounded by correlated variables such as income and education, which are also considered as determinants of utilization (Cordle & Tyroler, 1974; Feldstein & German, 1965). Adebonojo (1973) raised concern regarding the additional confounding factors of typical racial urban-suburban differentials and socioeconomic factors such as higher proportions of single parent families. The interest in establishing race as an independant determinant is likely more methodological than logical. In fact, race likely acts as a proxy for a variety of cultural and socio-economic factors which influence utilization through demand as well as need.

2.2.2 Determinants of Demand

Determinants of demand are those factors which influence the initiation and extent of service requisitions from the patient or the patient's parent(s). These can be divided into two broad categories: 1) environmental determinants which include social norms, social expectations, and social or community support systems, and 2) individual determinants include the individual's family support systems, attitudes toward health and illness, and socio-economic characteristics.

Environmental Determinants

Social norms and expectations regarding health and the health system are partly responsible for the demand and use of hospital services. Social norms which consider health care as a basic human right have been formalized in federal legislation which assures the accessibility of health care to all people (Hospital Insurance and Diagnostic Services Act, 1957; Medical Care Act, 1966). Such social values could conceivably increase demand by virtue of people who came forward to claim services which they perceived as "rightfully" theirs, people who would not necessarily do so if health care were a true market commodity. The value of health tends to be viewed as priceless within our society. Few are willing to consciously risk their health. To reduce the risk to health, society is likely to demand more medical care (Zimmerman, 1981).

Social expectations of health extend beyond the absence of disease and seem to embrace the World Health Organization's definition of complete physical, mental, and social well-being (Soderstrom, 1978). Through this broad social view of health, the jurisdiction for health services covers a very wide, and potentially expanding area. Demand for such a broad scope of services could be difficult to contain. Marc Lalonde noted in fact, that "the demand by the Canadian people for more and better personal health care continues unabated" (Lalonde, 1974, p. 11).

The social expectations of health care seem to be intensified when children are involved. Emotional responses to the plight of ill children are evident throughout the popular media. In terms of social priorities, no effort is too large, or price too great when the health and well-being of a child is at stake. This is one of the moral and social issues involved in the case of neonatal intensive care units. Thus, it seems that the emotionalism related to the care of children can in itself influence demand.

Social benevolence toward ill or disadvantaged children is expressed in many terms of social/medical support. In the United States, for example, children were targets for Medicaid, Head Start and EPSDT (early and periodic health screening, diagnosis and treatment) programs. The influence of these programs on demand for health services has been dramatic. One president of a major American children's center was quoted as saying "Children's hospitals have been shaped and sized by the Medicaid program, and as that program is cut back, we're facing disaster (Friedman, 1982).

The medical community also participates in shaping social values and expectations of health care. Many authors warn that demand is greatly influenced, and perhaps distorted, by the medical community and its tendency to encourage expectations of cure (Field, 1973; Fuchs, 1979; Maynard, 1979). Changes in medical practice can also influence perceptions of and thus, demand for appropriate health care. Demand for tonsillectomies, for example, has been influenced by the medical field, both in terms of determining need, and by discouraging public demand (Roos & Gilbert, 1979; Vayda, Morrison & Anderson, 1976).

Another example of changing medical judgement was the growing reluctance, after the Second World War, to take a young child "away from his home to a bed in hospital if his illness could be satisfactorily managed by making him an outpatient" (Nuffield Foundation, 1963). This reluctance arose from new knowledge of the mental development needs of children (Robinson & Clarke, 1980). The changing attitudes toward hospitalization of children were transmitted to parents and thus to society. As a result demand developed for alternatives to traditional inpatient care such as cure by parent units and day care units (Evans, Kinnis, Robinson, 1978; Robinson, Shah, Argue, Kinnis & Israels, 1969). Similarly, demand arose for child centered hospital environments, more parental involvement in care, play programs for recreation and in preparation for medical procedures, and extension programs for school lessons (Post, 1979; Robinson & Clarke, 1980). The intent of the changes was to keep children out of hospital if possible, but improve the situation in the hospital for situations where such care was required. In summary, the demand for hospital use in terms of admissions and length of stay was declining, but demands for total resources were not necessarily declining.

Individual Determinants

The individual determinants of demand and utilization include family support systems, attitudes toward health and certain socio-demographic characteristics. Because demand for children's services is primarily determined by parental choice and action (Wynne & Hull, 1977), determinants of demand apply principally to the child's parents and family. Several authors have indicated that demand is related to the perceptions and attitudes toward medical care (Grossman, 1972; Feldstein, 1967; Klarman, 1965). Crandall (1981) demonstrated that attitudes were stronger than any of the financial variables he included in a study of utilization of physician's services. Similarly, Goldman & Grossman (1978) argue that differences in quality, or its perception, influence choices in the market for physician's services. The role of attitudes in hospital utilization is however less clear.

Family and individual social circumstances are implicated as determinants of hospital demand and utilization in several studies. A study of admissions in two metropolitan public hospitals in the United States concluded that 21% of admissions were influenced by the social circumstances, such as supervision at home, of the individual (Mason, Bedwell, Zwagg, & Runyan, 1980). A similar study of children's admissions to hospital in England found that "over 20% were admitted primarily for social reasons" such as the lack of capacity of parents to care for their child at home (Wynne & Hull, 1977, p. 1140).

Family size has been frequently indicated as a social determinant of health service use. Picken and Ireland (1969), in a study of a British general practice, found that small family size (up to three children) was associated with more consultations for children. The authors felt that this could reflect the relative abundance of time and attention afforded to children in smaller families. Wolfe (1980), examining data from a Rochester community child health survey, also found that children from larger families were less likely to see a physician over a one year period. Colle and Grossman (1978) reported similar findings from a survey of utilization of physicians' services for American children between 1 and 5 years of age. Tessler (1980) cautions however that results of the studies on family size could be confounded by the influence of the child's ordinal position in the family. He suggests that later born children may be taken to a doctor less often than older siblings due to the increasing knowledge and experience of the parents in matters of child health. Given this hypothesis, a clustering of "first born" children in small families could account for the inverse relationship between family size and physician visits. Research regarding the influence of family size, or birth order in hospital utilization could not be located in this author's review of the literature.

Some research on use of pediatric health services focuses on the mother. Women have been recognized as the principal facilitators and brokers of health services for their children (Carpenter, 1980; Lewis & Lewis, 1977). Colle & Grossman (1978) for example, found that the mother's level of education was an important determinant of utilization of pediatric services. Carpenter (1980) examines the impact of family health care responsibilities of women in terms of home nursing care for children and escorting children to professional care. She notes that the increasing role of women in the workforce and the increasing tendency toward single parent families (primarily single mothers) will have an impact on formal health services and supportive social services.

The socio-economic class of the parent(s) has also been identified as a determinant of demand and utilization. Results however are conflicting, likely due to difficulties inherent in "measuring" class, and to the multiplicity of potentially confounding factors. Rosenthal (1964) identified income as an important factor in demand because the high and low income brackets accounted for 40% of the variation in prediction of patient days. Picken and Ireland (1969) found that children from upper social class families, with higher incomes, tended to consult relatively more often with physicians than children from other social classes. Colle and Grossman (1978) and Wolfe (1980) found similar associations of family income and tendency for children to be taken to a physician. Again, it is not clear whether income levels and hospital use among children is similarly related.

It is important in the discussions of determinants of utilization to remain cognizant of the immutability of factors as age, sex, and race and the unlikelihood of modifying factors such as education, family structure, or social attitudes and expectations. In fact there is some philosophical question as to the appropriateness of the government or other agencies attempting to influence these factors, even for the common good (Lalonde, 1974, p. 36). Without the capacity or authority to significantly influence patterns of utilization through factors related to need and demand, health care planners must concentrate on factors of the health system and its organization which affect levels of use. Only these factors are truly subject to manipulation from the health care field.

2.2.3 Determinants of Supply

Determinants of supply are those factors which influence the amount, type and level of resources available and accessible to the patient. These factors can be divided into two broad categories: 1) environmental determinants which include the technological ambience, the political and economic milieus, and distribution of resources across the health system, and 2) individual determinants which include individual circumstances such as proximity of residence to the nearest facility and an urban or rural residence.

Environmental Determinants

The impact of technology and advances in scientific frontiers on the allocation and consumption of health field resources has been discussed by many authors (Fuchs, 1968 and 1979; Mechanic, 1977, Reiser, 1978; Russell, 1976). The consensus in the literature is that increasing technology and medical advances lead to increasing resource consumption. Frequently cited examples include renal dialysis, open heart surgery, organ transplants, fetal monitoring and neonatal intensive care. The increased consumption is due in part to new opportunities for treating previously untreatable conditions (Fuchs, 1974, p. 92). Similarly, new technology may expand options for treatment which may be tried, sometimes regardless of their effectiveness, by virtue of what Fuchs (1968) describes as the "technological imperative" (p. 192). He suggests that, in a physician's view, the only legitimate constraint in delivering the best care possible is the state of the art. In this way, new technologies can be expected to increase consumption of resources by virtue of their availability.

Technological and medical advances have also been factors in shaping the allocation of resources. Increasing numbers of specialist fields and specialist practitioners have developed in response to the rapid advances in medical technology (Fuchs, 1974, p. 63). In addition, much of the specialist's technological expertise is dependant upon highly sophisticated equipment. Due to the costs of highly trained specialists and of sophisticated new equipment, allocation of these resources tends to be regionalized and/or centered near teaching hospitals. It is this regionalized, highly sophisticated technology which supports tertiary level care.

Specialization and regionalization of services can affect access to care in two general ways. Fuchs (1974) notes that the growth of specialty practices renders access to the medical system more difficult (p. 68). On the other hand, some authors argue that specialization and regionalization can increase access to services by making them more viable through economies of scale (Friedman, 1982; Katz, 1980).

Beyond sophisticated technology, the total volume of resources and patterns of resource distribution have also been reported as influencing access to service and utilization. As early as 1959, Roemer (1961a) identified a positive relationship between volume of bed supply and utilization. This relationship later became known as

Roemer's Law and was popularized through the cliche, "a built bed is a used bed." Many authors supported this tenet (Anderson, 1973; Fuchs, 1968; Harris, 1975a). Similarly the supply of physicians was seen to have a similar relationship with utilization (Evans, 1974; Gaag, Rutten & Praag, 1975; Ro, 1969, Roemer, 1961b). In reference to the pediatric age group however, Gaag (1975) noted that utilization for the "lower age groups" was not adequately explained by the variables (such as the number of beds, physicians, specialists, and nurses) in his regression (p. 272). Whether pediatric utilization is as resource sensitive as generic utilization remains unclear.

The politico-economic environment is also recognized as a factor influencing the service structure and the supply of resources. Fuchs (1979) cites unrelenting social and political pressure for a mere egalitarian society as a fundamental reason for increasing government involvement in the structure of health services through regulations and controls on resources. In Canada, this picture has led to the implementation of universal health insurance which is designed to eliminate financial barriers and thus, enhance access to care.

A feature of the Canadian insurance plan is the fee-for-service remuneration system. It has been suggested that this volume driven method of payment offers a financial incentive to physicians who maximize units of service delivery perhaps, even to excess (Evans, 1974; Soderstrom, 1978). Therefore, through financial incentives, physicians could inflate utilization of physician and hospital services. Indirectly then the economic structure of the system itself could conceivably influence supply and utilization of services.

Individual Daterminants

Individual circumstances ~~which~~ might influence access or availability of health services include location of residence and some economic factors. Location of residence has implications in terms of distance to facilities and in terms of urban-rural differences. Several authors have reported negative relationships between distance travelled to care and utilization of a given facility (Shannon, Bashshur, & Metzner, 1969; Studnicki, 1975b). In Studnicki's study (1975b), he found that obstetrical patients tended to minimize the distance travelled for admission but noted that distance was not necessarily the most important factor in the choice of a facility. Similarly, Bashshur, Shannon & Metzner (1971) found that "distance to medical services is important, but its effect as a barrier is a function of paths and goals" (p. 74). Through interviewing urban resident patients regarding the basis for their choices in facilities, Bashshur et al found that the nature of roads, means of transportation, values of the users (regarding the quality of medical care), and severity of the presenting problem were all important factors involved. Not surprisingly, they also found that patients who travelled the greatest distances to care had done so by choice and were people who had been referred or who emphasized the importance of quality care. Alternatively, patients who travelled the shortest distances had done so for the sake of convenience. From these works, it appears that distance minimization may be most important in terms of convenient access to medical care.

Other aspects of distance minimization have also been explored. In particular, the factor of time. Although reduced time is probably a component of convenience, time is also relevant to the concept of costs incurred by the patient. Maynard (1979) points out that the patient's opportunity costs, in terms of travel time and waiting time, may actually have significant effects on patterns of health care utilization. Similarly, Vertinsky and Uyeno (1973) found that the allocation of scarce time resources by consumers is one of the most important processes shaping the utilization patterns of health services" (p. 249). In the case of pediatrics, the scarce time resources would be the critical factor. A working single mother, for example, may be more likely to take her child to the nearest facility possible than a mother who has the time and inclination to travel to a facility of her choice. Caution is necessary with this interpretation however because research with the impact of time is usually applicable to health services in general, primarily non-emergent, time-intensive services such as physician visits. The impact of scarce time resources on hospital utilization is less clear. It may be that the relative importance and severity of hospitalized conditions negates the influence of time costs.

One study in California examined travel time in relation to general types of care received (Drosness & Lubin, 1966). They divided hospital admissions into obstetrics, medicine-surgery, and pediatrics. Using travel time delay curves (the rate of decrease in utilization as travel time to the facility increases), they found that the delay curves were very similar for the different types of care. They concluded that patient origin, as determined by birth registries, could accurately predict travel to a given facility, regardless of the type of care sought.

Another aspect of supply with respect to individual circumstances is that of a rural residence. Studnicki (1975a) noted that, "in rural areas, utilization of a particular facility is almost always a function of locational availability" (p. 13). In other words, rural patients will seek care at the nearest facility primarily because the next closest facility is a prohibitive distance away. Shannon, Bashshur & Metzner (1969) stated this more definitely by reporting that rural patients will travel only as far as necessary to obtain required services.

This does not necessarily mean however that rural patients have effectively restricted access to health services, just less choice of which facility to access. Hassinger & Hobbs (1973) demonstrated that among rural Ozark communities, patients had apparently common and normative patterns of hospital, and health service use. They suggest that this is because "mobility in obtaining a wide variety of service is well-established behavior in rural areas" (p. 521). The major effect of a rural residence on hospital utilization is however demonstrated through average length of stay (Anderson, 1973; Rosenthal, 1964). There was no evidence in the literature to indicate different patterns with respect to children.

2.2.4 Summary

The determinants of need, demand, and supply were reviewed on both the environmental and individual levels of influence in order to demonstrate the plethora of factors which affect utilization and their complex relationships. Despite the number of factors examined and the volume of research, a definitive and commonly accepted model of utilization has not been identified. This lack of direction in the literature was attributed to conceptual and methodological deficiencies in much of the research.

Only a small portion of the literature regarding utilization determinants dealt specifically with pediatric services; while an even smaller portion dealt with pediatric acute care services in hospitals. This lack of information specific to pediatrics, coupled with the lack of direction in the literature regarding general utilization, has precluded a comprehensive understanding of the processes and determinants which explain pediatric utilization of acute care hospitals.

2.3 Classification Systems

The mere existence of copious amounts of data does not necessarily guarantee the existence of useful information. In order to obtain information, the data must be systematically organized into meaningful groups or categories. One such method of data reduction which is often used to transform data into more useful information is that of classification. It is a general technique which has many applications in the health field. There are however, two well established applications: 1) disease classification, and 2) patient classification. A third, yet less established application is that of hospital classification. The following sections will discuss these three classification techniques and the literature relevant to them.

2.3.1 Disease Classification

Disease classification is the earliest known and most common type of classification in the health care field. The first formal system, developed in 1883, classified causes of death as a means to evaluate the effectiveness of public disease control efforts (World Health Organization, 1977, p. XIII). This system subsequently evolved to encompass comprehensive classifications of causes of morbidity as well as mortality and became known as the International Classification of Diseases (ICD). Its purpose is to provide a classification system for compiling statistics, with some assurance of international comparability. It is not intended to serve as a nomenclature of diseases (U.S. Department of Health, Education and Welfare, 1968, p. xxii).

The ICD is revised every ten years by the World Health Organization (WHO) in cooperation with several national committees (Lilienfeld, 1976, p. 52). Each revision supplants the previous editions. Various adaptations of each revision, which are designed for specific applications, have also emerged. The ICDA system for example, is adapted for use in the United States particularly for coding hospital records of diseases and operations (U.S. Department of Health, Education and Welfare, 1968, p. xxi). The ICDA-8 system is the eighth WHO revision of the ICD which was adapted for use in the United States and intended for use in the United States and intended for use between 1968 and 1978. The HICDA system has the same structure as ICDA-8 but was adapted for use by individual hospitals, not just for statistical coding. The H-ICDA-2 system is simply the second modification of the HICDA system. The ICD9 system is the ninth WHO revision of the ICD and as such, completely replaces all the aforementioned classification systems. It came into effect in January 1979. The ICD9-CM is the "clinical modification" of the same system.

The revisions generally "entail changes in code numbers and the addition of different disease entities to categories within a specific code" (Lilienfeld, 1976, p. 68). The basic structure of the system is however generally stable over time. Lilienfeld (1976) notes that the effects of the ICD revisions on comparability with existing statistics has been examined at least in terms of mortality statistics. In general, the effects seemed to be minimal for most diseases (Lilienfeld, 1976, p. 53). However, care must be taken to examine disease categories for changes between revisions when comparing ICD based statistics over time.

The basic structure of the ICD system is very similar to the elaborate heirarchical classification system of zoological taxonomy. There are seventeen generic categories, such as diseases of the circulatory system. Each category has five levels of subdivision which get progressively more specific. The system can therefore be used at several levels of specificity. In many of the revisions and modifications, it is the lower levels of specificity which are most affected. Thus, by using the system at a more general level (second or third digit specificity) there is a greater chance of categorical stability over time.

Statistics Canada produces an abridged version of the current ICD system which is titled the Canadian Diagnostic Code (CD). The CDC list corresponding to the ICD-7 contains 195 disease and injury categories which are generally composites of the over 900 ICD-9 three digit categories. The purpose of this regrouping was to rationalize the system to Canadian patterns of morbidity and mortality. The categories on tropical/communicable diseases for example greatly collapsed, compared to the ICD-9 classification.

The Commission on Professional and Hospital Activities has also been actively interested in classification systems. Through the Commission's Professional Activities Study (PAS), a large group of North American hospitals was collecting statistics which would aid evaluations of hospital performance. For this purpose, they required a universal system of classification for diseases and operations. The ICD classification system was adopted. The Commission recognized the ICD weaknesses in terms of use by individual hospitals and therefore, sponsored the modifications embodied in the H-ICDA system (Commission on Professional and Hospital Activities, 1968).

Other groups within the health field have recognized limitations of etiological or anatomical disease classifications and have thus developed supplementary disease classifications. Oncology specialists, for example, have devised staging systems for malignant diseases. Cancer staging generally categorizes tumors as localized, regionally metastasized, or distantly metastasized (Mausner & Bahn, 1974, p. 7). Each stage represents specific prognostic and therapeutic implications which would otherwise not be represented in the morphological categories used in the ICD classifications. The Kaiser Foundation, in preparing for a utilization study of all levels of health services, believed that the ICD system, developed for biomedical statistics, was not necessarily appropriate for analyses of utilization behavior. Consequently, they designed the "Kaiser Clinical-Behavioral Classification System" which grouped "those diseases likely to produce similar behavioral responses in persons with similar background characteristics" (Hurtado & Greenlick, 1971, p. 236).

The weaknesses of an etiological based classification system are identified and outlined by Bay, Leatt & Stinson (1982). Primarily, the etiological basis for some diseases is not certain. Many of these diseases are diagnosed by virtue of manifestation rather than etiology. Categorization for such diseases would therefore be relatively arbitrary and perhaps meaningless. Secondly, co-morbidity situations require judgements regarding the primary or dominant illness. Such decisions affect the consistency and homogeneity of each category. Finally, variations in illness intensity and therapeutic requirements within disease categories are not accounted for in etiological classifications. In response to these weaknesses and other needs for development, research into other foundations for classification emerged. One notable example is the area of patient classification.

2.3.2 Patient Classification

Patient centered classification systems are "based on observed similarities of patient characteristics rather than on cause or etiologic considerations" (Bay, Leatt & Stinson, 1982, p. 470). Similarly, the classification decisions are based on a range of patient situations and characteristics rather than a few etiological factors. This broad range of decision factors allows the classification to accommodate situations of co-morbidity and variations in illness intensity.

Patient classification has two general forms. Bay, Leatt, and Stinson (1982) differentiate between classification by types of care and by levels of care. The types of care format classifies manifest patient needs in terms of the types of health care or social services required; while the levels of care format classifies specific institutional service or resource needs in terms of the intensity of care, or level of care, required by the patient (Department of National Health and Welfare, 1973).

Types of care classification has been explored in relation to long term care patients by Bay, Leatt, and Stinson (1982) and in relation to neonatal intensive care patients by Bertinshaw (1980). Levels of care classification on the other hand has been more widely represented in the literature. Giovannetti (1979) is one of the leading authors and authorities in this area. Much of the research in levels of care classification has been prompted and conducted by nurses in an effort to objectively estimate the nursing resources needed by a patient or group of patients. Consequently, the acute care medical-surgical hospital wards have been the setting for many patient classification projects. Shah, Robinson, and Kinnis (1973) noted the levels of care classifications had not been attempted with children and thus, set out to devise such a system. More recently, Chagnon, Audette and Tilquin (1977) examined levels of care classifications for children. Thus, as the field evolves, more information regarding levels of care needs among specific patient groups, such as children, should emerge.

The main problem to date in much of the levels of care research is that validation for this type of classification has not always been adequately demonstrated (Department of National Health & Welfare, 1973). The existing validation studies tend to measure volume and/or the complexity of the nursing care which is being provided. This may be considered supporting evidence but is not theoretically accurate validation. What is required is the methodologically elaborate task of demonstrating validity of the theoretical construct of "nursing care needed" and its measurement. However, Giovannetti (1979) argues that this is an unfair criticism in that classification instruments actually group patients according to nursing care time required by pre-determined standards of care (p. 7). By this argument, the construct of nursing care "needed" is virtually irrelevant; yet other assessments of validity, such as predictive validity, become more important.

A measure of resource need, such as nursing care or bed needs would of course be the ideal basis for classification by level of care. On a more pragmatic level, however, there are several problems. Primarily, a universal definition of resource need does not exist. Secondly, assessments of individual patients would be impractical for large scale classifications, such as for system wide data collection and planning efforts. Finally, the lack of universal definitions renders inter-institutional comparisons relatively meaningless. The quantitative value of the typical levels of care classification systems are therefore lost on the larger scale questions of resource requirements. However, as Toll (1982) notes, it may be conceptually useful to classify resource requirements on a more generic leval.

The issue of broader classification by levels of care is relevant to this thesis, particularly in view of the large numbers of patients (or separations to be more accurate) involved. Generalized groupings of patient characteristics or attributes, which were also accessible through available data, were required for more generic classifications by levels of care. The literature revealed that several authors, faced with similar problems, classified levels of care in terms of diagnostic categories. Andersen Company et al (1978) for example, classed disease categories for typical pediatric illnesses into three groups (intense, average, and minimal) according to "illness severity weights," which were related to length of stay patterns (p. 46). Anderson and Wartz (1977) classified diseases as representative of pediatric tertiary care based on criteria related to the distance travelled to a care center. It is important to note that, as in other classifications by level of care, such generic categories do not represent actual quantifiable, levels of resource need. Instead, they represent conceptually relative levels of resource use, which may or may not reflect need.

The inadequacy of using patient classification systems to compare resource levels and use among institutions has been recognized in the health care field. Such systems were never intended for purposes of comparisons. Consequently, hospital classification systems are being developed to aid inter-institutional comparisons. These systems are necessarily based on more universally defined criteria than need or quality of care.

2.3.3 Hospital Classification

Hospital classification systems have been explored as a means to grouping relatively similar or homogeneous facilities, primarily for resource utilization comparisons. Such classification prevents the inherent unfairness of comparing the resource consumption of a small rural hospital for example with that of a large urban hospital. Different bases which have been suggested for hospital classifications include the number or scope of services or resources offered and measures of case mix. These approaches to hospital classification, and others, are discussed in this section.

Early attempts to classify hospitals into relatively similar groups centered on the number of beds or services within a hospital. The number of beds or services was assumed to account for differences in hospital outputs by virtue of their relationship to resource availability and diversity. Carr and Feldstein (1967), for example, used the number of hospital services provided by a hospital to account for differences among hospital resources and resource use. Morrill and Earickson (1968) suggested a four level hierarchical hospital classification based on hospital size (as determined by number of beds) and scope of services. Barry (1970) also classified hospitals according to services offered. Grouping was based on the presence or absence of forty criterion facilities and services. Lave and Lave (1971) used the number of beds to approximate hospital resource diversity. However, they also included factors such as teaching status of the hospital and urban/rural location of the hospital.

In 1974, the United States Social Security Administration grouped hospitals according to three factors; one of which was hospital size, and another was urban/rural location (Trivedi, 1978). The method was based on the rationale that hospitals which were similar with respect to the three criterion factors could also be expected to have similar costs per unit of output (provided that they operate efficiently). The limiting assumption was that the classification yielded relatively homogeneous groups. Phillip and Iyer (1975) challenged this assumption by arguing that the three "discretized" variables would represent only a few of the differences between hospitals. They proposed a classification scheme which would allow a number of variables to determine "natural" groupings of hospital characteristics through cluster analysis techniques (Phillip & Iyer, 1975; Trivedi, 1978). Interestingly however, hospitals were initially classified according to size and then further categorized according to a host of other variables.

Service scope, as a measure used to differentiate hospitals, has been termed by some as a surrogate measure of case mix (Klastorin & Watts, 1980). Thus, rather than using indirect measures of hospital activity, Klastorin and Watts (1980) believe that the direct "measurement of the diagnostic mix of patients treated in hospitals is essential to the characterization of activity in this industry" (p. 675). They continue to state that given the limited success of surrogate measures researchers are turning to the more direct diagnostic measures of case mix (Klastorin & Watts, 1980, p. 676).

The concept of case mix, although gaining contemporary prominence, is not new to health service researchers. In 1967, Feldstein, in a study of British hospitals, used relative proportions of admissions in nine diagnostic related categories (such as pediatrics, obstetrics, orthopedics, or surgery) to account for variations in hospital operating costs. Somewhat later, Lave, Lave and Silverman (1972) also found that diagnostic service groups were related to hospital costs.

The research challenge was to determine how diagnostic categories were related to cost. Evans (1971) analysed unit costs in relation to diagnostic specific and age-sex specific data and found that higher unit costs, per case, were incurred particularly in large metropolitan hospitals. He suggested that the higher costs reflected the tendency for more severely ill patients to be treated in large hospitals. In 1972, Evans and Walker expanded this idea by assuming that cases which were concentrated in fewer hospitals were more costly. From this assumption, based on information theory, Evans and Walker (1972) developed a measure of case mix which accounted for over eighty percent of the cost variances across hospitals. Klastorin and Watts (1978) criticise this assumption on the grounds that widely distributed high cost cases, such as myocardial infarctions, do exist and therefore contradict the assumption. In addition, they imply that case concentration is not necessarily an accurate proxy for case severity in that case concentration can occur due to factors other than severity (Klastorin & Watts, 1978).

Fetter and his associates (Fetter, Shin, Freeman, Averill & Thompson, 1980) were instrumental in the development of diagnostic related groups (DRGs). These groups were significant by virtue of their direct recognition of case complexity/severity. Patient discharge data were categorized into diagnostic groups "based on significant differences in the utilization of hospital resources, considering such additional features as age, sex, presence or absence of specified surgery and complications." (Thompson, Fetter & Mross, 1975, p. 302). Using the DRGs to compare hospitals, Thompson, Fetter & Mross (1975) found that there was a substantial difference in the diagnostic mix of patients treated in hospitals which were otherwise similar in terms of the "product" they delivered and their role in the community. As a result of this type of evidence, there has been increasing interest in the use of case mix or case complexity as a key variable in hospital classification (Horn & Schumacher, 1979). In addition to the use of DRGs for hospital classification, they have recently been used as a basis for hospital reimbursements in the United States (Inglehart, 1982b). The DRGs provide representations of hospital activity based on patient specific parameters of case complexity rather than on volume of service provided. The DRGs are then used to establish a prospective price per case which is reimbursed to a hospital regardless of the patient's length of stay or the volume of services received by the patient (Inglehart, 1982a). This DRG-based method of reimbursement is expected to aid governments in the battle to control costs of hospital care (Doremus, 1982).

Much of the hospital classification literature emphasizes the necessity of creating homogeneous groups (Horn & Schumacher, 1982; Hornbrook, 1982; Klastorin & Watts, 1980). One of the favored techniques for achieving homogeneous groups is cluster analysis (Bay, Nestman & Leatt, 1981; Phillip & Iyer, 1975; Trivedi, 1978). Interestingly, through clustering and other techniques, a relatively consistent pattern of hospital grouping has emerged (Toll, 1982, p. 39). This pattern relates to the normative levels of care which have become known as primary, secondary, and tertiary.

Initially, intrinsic hospital clusters were noted in terms of hospital size and service diversity. Morrill and Earickson (1968) for example, described the "hierarchy of hospital services" (p. 225). They noted that only a few hospitals, usually large ones, had highly specialized facilities and personnel while many hospitals, usually smaller ones, had a limited range of facilities and services. In addition, they argued that "the level of service of a hospital is a simple function of the presence or absence of various specializations" (Morrill & Earickson, 1968, p. 225). Similarly, Berry (1973) noted the inherent division and gradients of acute hospitals. One extreme was characterized by a large group of basic service hospitals, each with small numbers of beds and services. The other extreme was characterized by a small group of hospitals with large numbers of beds and services. Roemer (1979), observing the same tendency, described the "pyramid of functional differentials." He categorized very small hospitals as 50-100 beds, intermediate hospitals as 100-300 beds, and central hospitals as 500-1000 beds.

Some authors clearly identified the relationship of endogenous hospital clusters to the concept of levels of care. Trivedi (1978), for example, described the hospital clusters as following "the same general pattern of differences as those existing among primary, secondary, and tertiary care hospitals" (p. 263). Primary type hospitals were clustered in one group which was characterized by small hospitals (approximately 30 beds) in rural areas which were typically staffed by general practitioners. Tertiary hospitals were also clustered into one group. It was characterized by large, metropolitan hospitals (over 300 beds) which were staffed by a wide variety of medical specialists. Secondary hospitals were distributed among the other three categories.

It seems however, that few hospital classifications are actually based on the levels of care concept; rather the existing classification groupings seem to invite the levels of care analogy. Research by Toll (1982) is an exception in that hospitals are in fact classified on the basis of levels of care. In addition, Toll (1982) extends the concept to the classification of hospital beds by normative levels of care. Based on her research, Toll recommends that the levels of care concept be incorporated into future planning efforts regarding the provision of acute care beds and other resource allocations (p. 161). By extension, it would intuitively seem that the same principles and levels of classification could be applied to specific service areas, such as pediatrics.

2.3.4 Summary

Three major applications of classification techniques, relevant to the health care field, were reviewed in order to provide a logical and empirical basis for data reductions in this study of pediatric utilization. Through the review, it was found that disease classifications were primarily developed for morbidity and mortality statistics. Adaptations of these systems were often required for broader uses, such as for utilization research. Despite adaptations however, the disease classifications were inherently narrow in scope due to their etiological foundations. Patient classification systems, on the other hand, were based on a wide range of patient characteristics. The "levels of care" classifications were developed mainly to assist individual hospitals in rationalizing their staffing and resource allocations according to patient "needs/demands." The "types of care" patient classifications were applicable across institutions but did not provide a basis for institutional comparison as such. Hospital classification systems were developed in response to research and administrative desires to make equitable comparisons among hospitals.

2.4 Patient Origin-Destination Studies

The exploration of utilization patterns, as is the purpose of this study, can take on many forms. Exploration of such a large phenomenon generally begins with the identification of component factors for independent examination. Two predominant components of utilization patterns include patient movements (as in study objective 3) and area specific rates of consumption or utilization (as in study objective 2).

The study of patient movement, or flow, from a place of origin such as an area of residence, to a destination of care such as a hospital, is accomplished through origin-destination analyses. The calculation of utilization rates, suitable for comparisons, requires that the population using the resources of an area be known and quantifiable. However, because the population using area resources does not necessarily come from a circumscribed geographic location, for which the population is known, quantification of the population of "potential users" is often difficult. Patient origin-destination methodologies have, however, evolved such that service populations, and service areas, can be estimated based on patterns of patient movement rather than on geographic boundaries. In addition to providing the methodological means for analysing two principal components of utilization patterns, origin-destination studies allow information to be organized and analysed from two perspectives; that of the origin or community, and that of the destination or provider (Shaughnessy, 1981). Based on the relevance of patient origin-destination methodologies to the purpose and objectives of this study, the literature related to such methods is reviewed. The review is presented in three sections: 1) Patient movement and flow patterns, 2) delineation of service areas and service populations, and 3) comparative perspectives of resource utilization.

2.4.1 Patient Movement and Flow Patterns

Patient movement and flow patterns have been shown to be related to distance, time, and socio-economic factors. They may also be related to different functional characteristics of health care facilities (Toll, 1982, p. 48). Information regarding the factors influencing patient care-seeking behavior derived from origin-destination studies has been useful in evaluation and planning efforts. The examination of factors influencing patient flow, and their applications to health care planning are presented below.

The foundational study by Ciocco and Altenderter (1945) represents the genesis of patient flow studies. The authors employed origin-destination analysis methods to demonstrate and quantify the "pattern of dependence" of several Pennsylvania counties on the obstetrical services of other counties (Ciocco & Altenderter, 1945, p. 973). It was found that roughly 66% of the counties were dependent, to some degree, on outside centers for obstetrical care which were situated in about 18% of the counties. Counties which were neither care centers nor dependent comprised the remaining 16%. The degree of dependence, of one county or another, was considered to be a function of patient flow. Due to this patient movement, Ciocco and Altenderter argued that political (county) boundaries did not provide meaningful information regarding users of medical facilities. They suggested that medical trade areas be established for this purpose.

Since the Ciocco and Altenderter study, other researchers have employed patient origin-destination data and analysis methods to assess patterns of utilization. Sharp and McCarthy (1971) for example, examined origin-destination data from predominately rural areas of three American states. Based on radial mileage from origin to destination and the flow patterns of patients, Sharp and McCarthy concluded that the majority of patients travelled to the nearest hospital for care. They also noted, however, that distance was not the only factor involved in determining patient flow. Bashshur, Shannon & Metzner (1971), using a modified origin-destination analysis, examined the role of distance and socioeconomic factor in variations in the utilization of medical services in metropolitan Cleveland. The study included physician, dentist, and pharmacy visits as well as hospital visits. They found that although distance to medical services was an important factor of use, "a simple gradient hypothesis, however, was not found sufficient to explain differences within the area" (p. 74). Thus it appeared that, distance minimization was one, but not necessarily the predominant, determinant of patient flow.

Other authors suggested that time of travel, rather than distance, was a critical factor. Marrinson (1964) noted that distance, as a measure of accessibility, could be more appropriately represented by a "time circle," as opposed to a space circle. His argument was based on the influence of trade and transportation routes which tended to minimize the traditional limitations of travel distance. Shannon, Bashshur, & Metzner (1969) later confirmed Marrinson's observation and found that travel time, particularly in urban areas, was a more significant measure of accessibility than was travel distance. Origin-destination studies by Drosness, Reed and Lubin (1965) revealed similar results.

Temporal and spatial influences on utilization patterns were not the only relationships examined through origin-destination studies. Bashshur, Shannon & Metzner (1971) examined, in addition to distance, socio-economic factors such as religion, race, education and income which might influence patient flow. They found that such factors did in fact influence patient flow, particularly religion and race, which were closely related to income and education. The authors cautioned however, that Cleveland medical facilities tended to be ethnically grouped. There was, for example, a Jewish hospital in the area which most Jews travelled to by reasons of preference. Limitations aside, Bashshur's contribution was to highlight the importance of socio-economic variables in patient-flow studies.

> More attention to the attributes of the facilities and their relation to the social and health characteristics of patients might additionally reduce that residual variance which represents error or ignorance.
> (Bashshur, Shannon & Metzner, 1971, p. 75).

Attributes of the facilities or of special care provisions have also been recognized as factors related to patient flow. Sharp and McCarthy (1971), for example, found that, although patients tend to travel to the nearest hospital, patients were willing to travel greater distances for special needs. In addition, they were able to demonstrate the relationship of flow patterns to Morrill and Earickson's (1968) concept of hierarchical differentiation among hospitals (Toll, 1982, p. 49). They identified regions of net patient import, regions of net patient export, and regions of balanced import and export. A characteristic of "import" regions was the inclusion of a major medical/hospital center which attracted patients from surrounding regions. Export regions, on the other hand, included only local hospitals which provided relatively basic services. More specifically, Elaimy (1969) examined the relationship between hospital attributes, such as technological capacity and case-mix complexity, factors related to patient travel, such as time and distance, and patterns of utilization (Toll, 1982, p. 50). The findings suggested that a certain degree of natural matching existed between case complexity and hospital technological capacity through mechanisms of physician referrals and patient choices (Shonick, 1976, p. 71). Similarly, in a study of American pediatric hospital services, Andersen Co. et al (1978) found that dedicated children's hospitals received a much larger percentage of distant referrals, particularly of complicated conditions as compared to pediatric units in general hospitals.

Other aspects of the health system organization, beyond facility attributes and functions, have also been related to utilization patterns. Studnicki (1975b) found that organizational factors such as physician location and admission privileges were operative influences, along with distance minimization, in obstetrical utilization patterns. In an origin-destination study of nursing home utilization, Raasok (1979) found that organizational factors, such as facility ownership and accreditation status, could influence patterns of utilization.

In summary, the literature relevant to patient flow patterns suggests three principal factors influencing patient movement: 1) travel requirements as measured in distance or time, 2) socioeconomic characteristics of the user population, and 3) functional and organizational characteristics of care facilities. The tendency toward travel minimization is generally well accepted. Socioeconomic characteristics are often readily tabulated but difficult to conclusively relate to other phenomena. The last category, however, may benefit from further analyses.

Useful analyses may include the examination of specific utilization patterns by hospital functional differentiation such as levels of care.

2.4.2 Delineation of Service Areas and Service Populations

Delineation of hospital service constituencies and their geographic locations evolved largely in response to hospital planning efforts. Many authors noted that effective hospital planning would occur only when hospitals within a region knew who their patient populations were and how, or why, the populations came to arrive at a particular facility (MacStravic, 1978; Studnicki, 1975, p. 20).

Three approaches to service constituency delineation have evolved: 1) optimization, 2) administrative; and 3) ecological/empirical (Shonick, 1976, p. 62; Toll, 1980, p. 47). The optimization approach refers to the demarcation of a service area by planners or researchers who determine the market boundaries based on criteria for optimizing health care delivery. The administrative approach refers to the use of preexisting political, or other administrative boundaries, such as census districts, to define hospital service constituencies. Such an approach tends to disregard actual patterns of hospital use and has therefore been discouraged by some authors (Ciocco & Altenderter, 1945; Teixeira, 1975). The ecological approach, on the other hand, incorporates actual patterns of use and patient flow in the delineation of service constituencies. The most important distinction is that the ecological approach derives a geographic service area from the distribution of the service population, as determined by patient flow. The optimization and administrative approaches, by contrast, derive the service populations from established geographic boundaries.

In many early hospital planning efforts, service areas were primarily defined as geographic subdivisions of planning regions (Shonick, 1976, p. 61). Persons living in the "service area" were generally assumed to seek care at facilities within that area. Utilization behavior however, being determined to some degree by patient choice regarding location of care, did not necessarily conform to this assumption. Numbers of residents could be expected to cross such administrative boundaries. Consequently, the service population, used as the denominator for rate calculations, was inaccurately assumed to be the population of the service area.

One of the first studies to derive service areas from actual utilization patterns was conducted by Lembcke (1952). Using patient origin-destination data, Lembcke attempted to assess quality of medical care through the comparison of appendectomy rates of various service areas. The innovation of his work was in not assuming that patients resided in, and received care in, the same service area. Instead, he allocated each surgery event to the area of patient origin, regardless of where the operation was performed. Individual hospital service areas were then delineated according to townships which had a large majority (75 to 95%) of all their hospitalizations occurring at that individual hospital (Lembcke, 1952, p. 277).

In a later study, Poland and Lembcke (1962), empirically defined hospital service areas using the "equal-likelihood" principal of patient flow. The service areas boundaries represented the points at which a patient was equally likely to travel to one particular hospital as he was to travel to any of all the other hospitals (Griffith, 1972, pp. 68-73; Shonick, 1976, pp. 65-67). Additional contributions of this work included a subsequent analysis of patient flow among the service areas which indicated that hospitals with specialized technological services tended to draw patients from greater distances than hospitals without such services. Similarly, the distance typically travelled for service was positively related to disease complexity (Shonick, 1976, pp. 65-67). Such findings laid the foundation for use of this gravity model to explain and predict patterns of utilization.

The gravity model, borrowed from the Newtonian theory of gravity, states that attractive forces between two bodies "increases with the product of their masses and decreases with the distance between them" (Meade, 1974, p. 360). Meade (1974) employed the gravity model, adapted for sociological applications, to delineate hospital service areas in Idaho. The "mass" of individual hospitals was measured according to the concentration of beds, facilities and physicians. Thus, the hospitals with more beds, specialized physicians and services, as compared to adjacent hospitals, possessed more drawing power. The hospital service area was then delineated by the distance over which the hospital exerted its attractive force. The resulting areas were compared with known patient origin data and were found to approximate reality (Meade, 1974, p. 362). Meade was careful to point out, however, that the methodology was necessarily limited to rural applications so as to avoid overlapping service areas.

With a broader perspective, Paine and Wilson (1975) set out to establish large regional service areas each encompassing a number of hospitals. Using patient origin-destination data, they divided Alberta into six regions such that at least 90% of the residents within a given region would also receive hospital care in that region. Regions were composed of aggregated census subdivisions. One criticism of this study, which could also be leveled against any of the aforementioned studies, is that basic patient flow patterns were based on a geographic unit, census subdivision, which could subsume more than hospital. This situation rendered the areas as characteristically "unequal" and therefore potentially inappropriate for comparison of utilization patterns and patient flow. After reviewing methods of determining service populations, including Paine and Wilson's work, Teixeira (1975) recommended that utilization studies, particularly of acute care hospitals in Alberta, use geographic areas which include only one hospital (i.e. general hospital districts).

The issue of one hospital per geographic unit for origin-destination studies has been a notorious problem for urban areas with several hospitals. "Patients, especially in metropolitan areas are not distributed to hospital in an optimal spatial pattern" (Studnicki, 1975b, p. 680). Drosness, Reed and Lubin (1965) addressed this problem by using computer graphics techniques to map California urban hospital service areas according to the proportion of admissions each urban census tract contributed to the total admissions of a given hospital. Even with this technique, considerable boundary crossing behavior was noted in patient flow patterns. Morrill and Earickson (1968b) in a study of Chicago area hospitals and patients, also noted significant boundary crossing behavior. They were able to show that much of this variation was due to hospital characteristics such as site and service scope. Their work implied that hospital service areas would vary in size, shape, and population according to characteristics of the hospital. This situation contradicted the accepted planning assumption of the influence of distance minimization behavior.

Studnicki (1976) summarized the inapplicability of distance minimization in metropolitan areas by stating that:

> In large cities and their surrounding urbanized areas the effect of physical accessibility on the distribution of patients to hospitals becomes confused by the large number of alternative hospitals, the relatively small distances between choices, and the large numbers of patients services.
> (Studnicki, 1975b, p. 681).

Studnicki then set out to quantify the divergence of actual urban patient flow patterns and flow patterns which would be expected with an "optimal accessibility model." He analysed birth records from Baltimore obstetrical admissions and found that only 25% of the births occurred at the nearest hospital (Studnicki, 1975b, p. 685). When hospitals were grouped in quartiles of accessibility to patient locations, 50% of the births occurred in the first quartile (closest hospitals), 17% at second quartile hospitals, 13% at third quartile hospitals, and 20% at fourth quartile hospitals (furthest hospitals). A stepwise regression analysis identified variables which explained the variation in "spatial efficiency" of obstetrical patient flow. He found that distance, or effort minimization, was not entirely applicable to poor, typically nonwhite patients whose choices of hospital were limited by inability to pay and differential admission policies (Studnicki, 1975b, p. 689). The implication is that universal health insurance may decrease some of the "atypical" patterns of urban patient flow. Studnicki cautions, however, that patterns of flow would still be heavily influenced by physician location and admitting privileges (p. 690).

The unsuccessful attempts to delineate clearly independent geographic service areas, at least in metropolitan areas, created a methodological problem for calculating hospital service populations. It became clear that planners needed an alternative to the traditional practice of defining the service population as the population contained in a specified geographic catchment area. Griffith (1972) responded to this need by developing, or at least formalizing, two indices of patient flow which identified hospital service populations. The indices were particularly important in that they accounted for imported referral patients in hospital service populations. His method involved the construction of a utilization matrix which represented the number of admissions coming from an array of geographic areas (not just the expected catchment area) to the array of hospitals under study. The relevance index (RI) represented the preparation of all the admissions originating from a particular geographic area which went to a given hospital (Griffith, 1972, p. 76). The RI served as a measure of a hospital's market share within each identified geographic area. A hospital service population could then be calculated by multiplying the known population of each geographic area by its RI market share, and then summating the population contribution from each area (Griffith, 1972, p. 76). The second index, the commitment index (CI) was used to represent the degree to which a particular hospital served a given geographic area.

It was calculated as the proportion of a hospital's total admissions which originated from a particular geographic area (Griffith, 1972, p. 76).

Griffith's method of delineating service areas and populations without the limiting geographical concept of catchment areas was extended by Bay and Nestman in 1980. In a study using Alberta utilization data, they demonstrated a hospital service population could be calculated without a specifically delineated service area. In addition, their service population model could be applied to many hospitals at a provincial level, rather than concentrating on individual hospitals as Griffith did. They also demonstrated that the RI and CI could be calculated using available utilization measures, other than admissions, such as patient days. Perhaps most importantly, Bay and Nestman (1980) emphasized the theoretical imperative of homogeneity assumptions with regard to patterns of physician practice and referral, and hospital specialization. They noted, in their study of Alberta data, that there was reason to question the assumptions of homogeneity. Interpretation of results which suggested significant variations in resource allocation and use, among hospitals and districts, was therefore cautiously limited.

Based on the investigational experience, and empirical evidence reported in the literature, it appears that delineation of service areas and populations based on patient flow patterns, rather than on geographic areas, represents the method of choice. Furthermore, it appears that the proportionate area and population models developed by Griffith (1972) and Bay and Nestman (1980) represent the current "state of the art" methodologies.

2.4.3 Comparative Perspectives of Resource Utilization

Evaluation of resource utilization, in terms of equitable distribution and efficient use, has been limited by the lack of valid or even universally accepted absolute standards. Consequently, evaluation efforts have turned to relative comparisons of resource utilization among hospitals, and among regions. A prerequisite for such comparative evaluations and analyses is the ability to calculate comparable rates of resource utilization. Recent authors have argued strongly for the use of per-capita utilization rates based on service populations which account for patient flow patterns (Bay & Nestman, 1980 and 1984; Shaughnessy, 1982).

The two generally accepted methods of calculating population based, per-capita utilization rates were summarized in a paper by Shaughnessy (1982). The two methods arose from two different perspectives of comparison; the community based (CB) perspective/method, and provider based (PB) perspective/method. The CB method begins with the specification of a geographic area (community). Then, the total hospital (or other health service) utilization experience of all residents in the specified area is determined, regardless of where the utilization occurred. The per-capita rate is obtained by dividing the area's total utilization experience by the area's total population, preferably adjusted for age-sex variations. The rates however, can only be considered truly comparable if characteristics of the areas for comparison are similar; similar in terms of size, health service delivery resources, and sociodemographics for example. Such homogeneity must often be assumed rather than demonstrated.

In addition to the aforementioned requirements for meaningful CB rate comparisons, there is also evidence to suggest that rates should be based on relatively small geographic areas. Wennberg and Gittelsohn (1973) found that wide variations in resource utilization were apparent among small areas, such as neighboring communities, which were obscured when aggregated analyses were conducted from a regional perspective.

The PB method views resource use from the perspective of a hospital or other service provider. Consequently, the rate numerator represents the total resources used, or costs incurred, by the hospital. The service population denominator is calculated by using the relevance index (Griffith, 1972) to derive population proportions relevant to each community served by the hospital, and then summating shares of the community populations to yield the hospital's service population (Shaughnessy, 1982). Due to hospital perspective, PB utilization rates can only be considered truly comparable if hospitals for comparison are similar; similar

similar in terms of size, scope of service, and typical patient mix for example. Often, rate comparisons are made without assurances of such homogeneity. However, rather than dismiss "inequitable" comparisons entirely, it is probably more important that their limitations be recognized.

The perspective/method of rate calculation depends of course on the perspective of the research question (MacDonald, 1982, p. 77). Wennberg and Gittelsohn (1973) for example, were interested in the variation of resource use among different areas of Vermont. They used a CB method to calculate population based, area specific utilization rates. To derive the rate numerator, they allocated "facilities to each service area of the state in proportion to the use of these facilities by residents" (Wennberg & Gittelsohn, 1973, p. 1103). The summation of the proportional facility contributions from all hospitals represented the total resources committed, or "allocated," to the service area. In a later study, Wennberg and Gittelsohn (1982) used the same CB approach to examine variations in utilization of surgical resources in six New England states. Another application of the CB method was used in a 1981 study of variation in Alberta's regional surgical utilization rates conducted by the Alberta Hospital Utilization Committee (Alberta Hospital Utilization Committee, 1981). Similarly, in a longitudinal study of regional variations of Alberta surgical utilization rates, MacDonald (1982) employed the CB perspective and method.

A particularly innovative application of the CB approach can be found in the work of Anderson and Wertz (1977). Although their goal was not to calculate regional utilization rates for comparison, the CB perspective was used to assess resource utilization in the Vancouver area. Their purpose was to estimate the tertiary care resource requirements, in terms of beds, for a proposed specialty pediatric hospital in Vancouver. To accomplish this, they identified two pediatric service populations: the referral population and the urban population. The referral population was identified as children whose residence was in a geographic area so distant from Vancouver (at least 100 miles) that they were unlikely to seek care levels other than tertiary referral care in Vancouver (Anderson & Wertz, 1977, p. 408). The urban population was to be the remaining pediatric population. Vancouver area hospital separations of children generated by the referral population were assumed to represent tertiary care events. Proportions of tertiary separations were calculated for a number of diagnostic rubrics. The proportion of "tertiary care" in each disease category was then assumed to apply also to the urban population. Having estimated the proportion of all Vancouver area pediatric separations which represented tertiary care requirements, bed equivalent requirements could be calculated, after adjustments were made for lengths of stay and occupancy rate standards.

Researchers interested in evaluating hospital performance, in terms of providing service to a population, employ the PB perspective/method of deriving population based utilization rates. This literature in this area is dominated by Griffith. Griffith (1978) presented a number of PB per-capita measures of "hospital performance" related to service quantity, cost, or quality. Later, Griffith et al (1981) applied these measures to Michigan hospitals and demonstrated their potential usefulness. Griffith recognized the soft data limitations of quality measures, such as patient perceptions of quality but emphasized their importance in evaluation and planning. Griffith was also concerned about his methods lack of case-mix adjustments for hospital comparisons. He recommended this as an area for refinement and further research.

The CB and PB perspectives are actually complementary approaches which each provide different types of information, rather than providing two paths to the same information. Shaughnessy (1982) demonstrated how both PB and CB measures could be used in tandem to develop a profile of resource allocation to regions and related resource utilization by care providers. Bay and Nestman (1984) used this tandem strategy to derive population based measures of "distribution of acute care beds for each district [in Alberta] and service load for each hospital" (p. 1). The bed distribution index (BDI) measured the distribution of beds over a geographic district in relation to the population while the service population index (SPI) measured the number of people served by each hospital bed (Bay & Nestman, 1984, p. 8). The authors cautioned that even though the BDI alone could provide useful information for identifying over or underbedded districts, it would be difficult to translate this information into reallocation decisions because resources are generally allocated to hospitals, not districts. Consequently, it would also be necessary to measure hospital service load (SPI) in order to identify over or under loaded facilities. Thus, it was clear that any system wide resource allocation planning would require information from both the CB and PB perspectives.

2.4.4 Summary

The use of patient origin-destination data has been instrumental in the proliferation of knowledge regarding utilization behaviors, such as patient flow patterns, and the factors which influence these behaviors. Over time it became clear that physical and financial access to care were only two of many factors influencing patterns of utilization. An area requiring further explanation is the impact of functional and organizational characteristics of the care providers, such as differing levels of service and care, on the patterns of utilization and patient flow.

Patient origin-destination methodologies have also evolved over the past few decades such that researchers are no longer solely dependent on geographic areas and jurisdictional boundaries to delineate service areas and service populations. Sophisticated methods now account for a dynamic service population characterized by relatively fluid patterns of movement. In addition, recently developed measures of patient flow, the RI and CI, provide useful bases for grouping hospitals or districts according to similarities in utilization patterns.

Finally, origin-destination analyses can be approached from either the CB or PB perspective. The CB perspective/method can provide information regarding per capita resource utilization while the PB perspective/method can provide information regarding per capita resource allocation. Recent authors have demonstrated the utility and wisdom of analysing patterns of utilization from both perspectives.

2.5 Chapter Summary

The review of literature regarding determinants of utilization failed to uncover a comprehensive theory or model of utilization. Conceptual and methodological deficiencies and inconsistencies in the literature were considered to be major factors contributing to the relative immaturity and directionless nature of the literature base. Despite the lack of focus, a number of factors were identified as being related in some manner, albeit not necessarily in a consistent manner, to the phenomena of utilization. These factors were discussed according to a framework which defined utilization as an intersection of need, demand, and supply variables which operated from individual and environmental levels of influence.

The literature regarding classification systems which might be applicable to this study of pediatric utilization, revealed three potentially appropriate areas for data reduction through classification: disease, patient, and hospital classifications. Disease classification systems were seen to be useful for reducing volumes of morbidity data but were also inherently limited in the scope of data they could summarize due to their etiological foundations. Patient classification systems, on the other hand, could summarize a wide range of patient characteristics according to the types of care/facilities required or according to the levels of care/service resources required. Such classifications were generally designed to characterize a patient, or group of patients, in relation to objective criteria which would promote rational patient placement and staffing allocations. Hospital classification systems were developed to group hospitals according to their similarity on certain characteristics. Such classification was intended to ensure equitable comparisons among hospitals, particularly with respect to measures of performance and resource consumption.

The last section of the review presented literature regarding patient origin-destination methodologies. Patient flow analyses of origin-destination data were shown to evolve beyond the examination of distance, or physical access, as the primary determinant of patient movement. Researchers have expanded flow studies to include assessments of patient choices for location of care and the influence of hospital service and facility characteristics on patient movement. Origin-destination analyses have also become more sophisticated with respect to the delineation of service areas and service populations. The determination of service areas and populations based on patient flow patterns and proportions of market shares have rendered the specification of geographic boundaries for catchment areas obsolete. Finally, the recent emphasis on the concept of using both CB and PB analyses in tandem has been an important contribution to the literature and to the development of planning methodologies.

In total, the review led this author to conclude that research regarding patterns of pediatric utilization of hospital services is conspicious only by virtue of its absence. This suggested that empirical foundations for planning pediatric hospital services, on a provincial or local level, were lacking. From this perspective, an investigation of pediatric utilization in Alberta seemed warranted. The review of literature regarding generic utilization and methods for analysing utilization patterns revealed a number of methodological points which were subsequently incorporated into this study of pediatric utilization.

CHAPTER III

METHODOLOGY

As outlined in Chapter I, the purpose of this investigation was to explore patterns of utilization of acute hospital pediatric services in Alberta. Pursuant to this goal, five objectives were identified:

1) to identify the level of acute hospital service utilization by the Alberta pediatric service population, and its subpopulations, and associated trends in utilization over a ten year period,
2) to identify and compare district and regional utilization rates over time from a community based perspective,
3) to identify patterns of patient movement from both community based and provider based perspectives,
4) to identify and compare disease specific patterns of utilization with a view toward developing comparisons of utilization by levels of care based on diagnostic groupings,
5) to estimate the extent of pediatric service utilization in Alberta, which could be classified as tertiary level care.

To achieve the goal and objectives, the research project was divided into three stages: 1) developing the overall investigational strategy, 2) acquiring and assessing the relevant data, and 3) developing and executing specific analytical steps in accordance with the identified research objectives. The discussion presented in this chapter is organized to reflect these three stages of the research project.

3.1 Investigational Strategy

The investigational strategy evolved from two major processes; development of a conceptual framework and selection of appropriate research perspectives and methods. The results of these processes translated the research goal into operational terms and formed the superstructure for the investigation.

The first process was the development of a conceptual framework. The intent was to establish a theoretical foundation, supported by empirical evidence, for trends in, and determinants of, utilization in general and pediatric utilization in particular. Such a foundation was required to direct the examination of pediatric utilization patterns in Alberta. Relevant literature was therefore reviewed to uncover existing theoretical models and empirical experience regarding utilization. Results of the review were presented in Chapter II.

The literature regarding generalized utilization patterns was extensive. With respect to the specific topic of pediatric utilization, however, the literature offered neither a specific theoretical framework nor a generally accepted adaptation of generic utilization models to the pediatric case. Consequently, a conceptual model was developed for purposes of this investigation based on a synthesis and interpretation of the existing literature regarding generic and pediatric utilization. The conceptual model was also presented in Chapter II.

The second process was to determine which research perspective and methods would be most appropriate in view of the research goal and objectives. Research perspectives can be broadly grouped into two categories; the inferential and the descriptive perspectives. The "appropriate" perspective is determined primarily by the research goal. If the goal is to demonstrate a causal relationship between identified variables, the inferential perspective is indicated (Bauman, 1980, p. 78). This requires a well defined hypothesis and therefore implies a knowledge base which is sufficient to permit predictions regarding the nature of the relationship in question. If, on the other hand, the research goal is simply to identify and document the distribution and association of variables, then a descriptive perspective is indicated (Bauman, 1980, p. 64).

The goal, and objectives, outlined for an examination of pediatric utilization in Alberta were primarily descriptive in nature. In addition, the intention of the investigation was to examine the entire population, rather than a sample, of the pediatric patients in Alberta. There would be no need, therefore, to draw inferences (dependant upon the hypothesis testing of the inferential perspective) regarding the population based on a sample. As a result, the descriptive perspective was deemed most appropriate for this investigation. The inferential perspective was not only considered unnecessary, it was also considered premature, and therefore inappropriate, for research in this area due to the lack of theoretical foundations on which well defined hypotheses could be based.

Research methods were selected on the basis of appropriateness to the goal and objectives. Notably, the first two objectives refer to the examination of trends and patterns of utilization over time. To satisfy these objectives, longitudinal data were required. Such data can be obtained through retrospective or prospective means. Retrospective data are often available through historical records and are thus relatively accessible and inexpensive. Prospective longitudinal data, however, must be collected over time and are thus relatively costly and logistically more difficult. Due to the ready availability of historical utilization data files, retrospective data collection was the chosen method. Utilization data were available for the ten year period from 1971 to 1980. This time span was, therefore, designated as the study period.

The aim of the investigation was to generate information, the nature of which is indicated in the research objectives, which would aid strategic planning efforts regarding the future of Alberta's hospital pediatric services. Many of the salient planning issues were expected to center on resource allocation from a systems perspective. This anticipated application of the research lead to the selection of research methods which employed population based per capita measures of resource consumption and supply. This selection was based on the conviction that:

> In order to achieve an equitable allocation of resources among communities within a planning jurisdiction, it is necessary to match the amount of resources available with the population to be served...
> (Bay & Nestman, 1984, p. 3).

Bay and Nestman (1984) argue strongly for per-capita measures in that:

> Because of the strong effects of supply on utilization and the free movement of patients across hospital district boundaries, it is apparent that the direct use of utilization statistics, including occupancy rates, as a basis for hospital bed [resource] allocation seems illogical and inappropriate to overcome the difficulties associated with the direct use of utilization data, a population-based approach appears to be more appropriate in dealing with the bed [resource] reallocation problem. (p. 4).

In support, the literature review revealed that evolving research methods for area-wide utilization reviews had demonstrated the utility and wisdom of calculating per capita utilization rates, adjusted for age and sex variations, to enhance comparability among areas (Bay & Nestman, 1980; Griffith, 1978).

There are two classes of methods for computing per capita measures of utilization. Community-based (CB) analyses construct per capita measures pertaining to the population of a defined geographic area (Shaughnessy, 1982, p. 62). Utilization rates calculated with the CB method would, therefore, be in reference to areas such as hospital districts or regional groups of districts. The second research objective of identifying district and regional utilization rates would therefore be accomplished through CB analyses. The second class, the provider-based (PB) analyses, constructs measures which characterize a given provider or set of providers in terms of per capita measures (Shaughnessy, 1982, p. 62). Patterns of utilization relative to specific providers, or hospitals, could, therefore, be examined through PB analyses.

A methodological extension of CB and PB analyses also allowed examination of patient movements according to origin-destination matrices. The origin vector typically represents the district of patient residence (a community based variable) while the destination vector typically represents the hospital where the patient receives care (a provider based variable). The third objective of identifying patterns of patient movement would therefore be accomplished through a combination of CB and PB analyses, otherwise known as origin-destination analyses. There were no alternative methods for examining patient movement.

Of major strategic concern was the comparability of calculated utilization rates. To ensure optimum comparability, age-sex adjusted population data would be used for all per capita rate calculations. In addition, disease specific utilization rates would be calculated for comparisons in recognition of the primary role that disease or diagnosis plays in determining utilization rates and patterns of rate variations. This strategy was consistent with the fourth research objective of comparing disease specific patterns of utilization.

Similarly, it was assumed that comparability would be enhanced, at least qualitatively, if patterns of utilization were examined within qualitatively similar disease categories identified as "levels of care." As noted in the literature review, generic levels of care, beyond the classification of individual patients, have been differentiated on the basis of distance travelled to care (Anderson & Wertz, 1977) and diagnostic groups weighted by length of stay patterns (Andersen Company et al., 1978). The weighting by length of stay was assumed to represent intensity of resource use. Because this assumption was tenuous, particularly in a predominantly rural province such as Alberta, this basis for differentiating levels of care was rejected. Alternatively, levels of care would be differentiated according to the travel patterns, and patient movements observed within diagnostic categories under the assumption that relatively severe illnesses typically required patient travel to facilities with intense, concentrated resources. This strategy of differentiating levels of care was consistent with research objectives four and five.

In summary, the overall strategy developed for this investigation was to conduct the research from a descriptive, rather than an inferential, perspective. Strategies regarding research methods included the use of: retrospective rather than prospective longitudinal data for pragmatic reasons, a population based approach to utilization rates to ensure applicability to resource allocation issues, age-sex adjusted and disease specific utilization rates to enhance the comparability of rates, and the differentiation of levels of care to provide qualitative conceptual categorizations for analyses of resource consumption.

3.2 Data File Development

Presented in this section are the principal data sources and the methods used to organize these data into an integrated file which would support the intended analyses. In general, the data were obtained from federal and provincial government sources. The federal government was the primary source for detailed census data. The provincial government provided the utilization data which were generated in vast quantities through the provincial health information system. The health information system data are particularly valuable for utilization and planning studies in that they are consistently and comprehensively collected throughout the province. With this relatively complete and homogeneous coverage, researchers and planners can be reasonably assured of an unbiased representation of the provincial health service experience.

There are several limitations, however, to the use of such massive data files. Principally, a great deal of time is required to collect, verify and aggregate the data. Particularly in the case of the utilization data, many agencies are involved, each requiring additional time to process and distribute the data. Consequently, a significant time delay, on the order of a year or two, can occur before the data are available for use. Another limitation is that the volume of data and the series of agency level aggregations they undergo prevent the researcher or planner from exerting direct control over the data. Similarly, without direct access to the source data, evaluation of data quality is not feasible. Data quality is, however, assured to some degree by virtue of the verification procedures and quality control checks routinely performed by the data processing agencies involved--The Commission on Hospital and Professional Activities (CPHA) and Statistics Canada. Based on this assurance, the data obtained for this investigation were assumed to be substantially complete and not systematically biased.

3.2.1 Census Data

The calculation of per-capita utilization rates required, for the denominator, an accurate accounting of persons or potential users in the study area. The primary data source for determining the number of persons for a given area and time was the federal census figures. Census data were available for years 1971, 1976, and 1981. Statistics Canada released the data according to enumeration areas (EA). The EA was the smallest unit of area and typically did not cross other major geographic boundaries. Therefore, by aggregating the EAs, it was possible to tabulate the census population in terms of other geographic boundaries, such as hospital districts. Such a retabulation of the census population, into 102 hospital districts according to sex and 5 year age categories, was performed by the provincial government. These reorganized census data were obtained for this investigation.

The census data were, by nature, cross-sectional observations. All data obtained were referenced to June 1 of the census year. The dynamic element of time was, therefore, not inherent in these data. It was also recognized that census observations often failed to represent complete enumeration and could underestimate the population by as much as 5%. It was assumed, however, that such underestimates were unavoidable errors which could occur in all segments of the population, and thus, no systematic distortions of the data were expected.

Data Modifications

Census data for the pediatric population were extracted and grouped into eight age-sex categories. There were four age categories, each with two subdivisions for sex; under 1 year of age, ages 1-4, ages 5-9 and, ages 10-14. As noted in the literature review, there was evidence to suggest that health service need and utilization depend largely on the age-sex composition of the population. In order to achieve unbiased comparisons of rate variations, it was therefore necessary to remove the confounding factor of rate variation due to the age-sex composition of the population.

Two methods of rate standardization--holding the effect of age and sex variation constant--were examined. The direct method was deemed too cumbersome for this investigation in that age-sex specific rates would have to be calculated for each hospital district. The indirect method for age-sex adjustment was therefore chosen. Using this method, the more stable rates of a larger, yet comparable population, were applied to the smaller study groups (Mausner & Bahn, 1974). The calculation involved adjusting the denominators (in numbers of persons) rather than adjusting the numerators (in numbers of cases), while using the provincial average for utilization as the common standard.

The actual procedure used to calculate the adjustment was the weighted-sum approach as described by Bay and Nestman (1980). The weights used were based on utilization figures from 1971, 1976 and 1980 combined. Thus, only one set of weights was applied to the crude population figures for the three census years (See Appendix A for details). This procedure reduced the computational requirements and rendered the resulting service population figures longitudinally comparable. The service population within a defined geographic area was equal to the age-sex adjusted census population of that area.

Crude population figures were only available for the three census years. To calculate yearly utilization rates, estimates of district populations and service populations were required for intercensal years. Two commonly accepted methods of population projection were examined; the linear progression model and the exponential progression model. It was felt that the exponential model would most accurately represent the expected growth curve of any given population. The linear model was deemed too simplistic in the assumption that populations increase (or decrease) by a given number of persons per unit time. The exponential model assumed growth to be compounded such that the actual number of persons added to the population per unit of time would be proportional to the number of persons in that year, although, the rate of increase could be relatively stable.

A constant yearly rate of growth was assumed to exist for the pediatric population in each district between the years 1971 and 1976, and between 1976 and 1981. District growth rates were calculated for both census and service populations. Pediatric populations for intercensal years were then calculated by applying the growth rates first to the census year and then to each successive year in the five year range. (See Appendix A for details.) One final, yet minor, adjustment was made to maximize the comparability of census and service population figures. Each district service population was multiplied by a factor which would equilibrate the provincial census population and the provincial service population.

3.2.2 Professional Activities Studies (PAS) Data

The calculation of utilization rates also required, for the numerator, accurate measures of utilization. The principal source of data regarding hospital use was hospital patient "separation abstracts" which were routinely collected and compiled for all Albertan hospitals by the Commission on Professional and Hospital Activities (CPHA) in Ann Arbor, Michigan. These compiled data were typically referred to as PAS (Professional Activities Studies) data. The records obtained for this investigation were provincial government computer tapes which contained PAS data from January 1971 through March 1981 for all acute care hospitals in Alberta. The data of particular relevance to this investigation were: 1) age of patient on admission, 2) patient sex, 3) primary diagnosis, 4) length of stay, 5) admitting hospital, and 6) hospital district corresponding to patient residence.

As noted above, the unit of data collection was hospital separation. Consequently, episodes of illness or individual cases could be over represented in that they would be counted more than once if hospital transfers (recorded through separation abstracts) were involved. Thus, the number of cases treated in primary or secondary service level facilities may be particularly over-represented. In recognition of this tendency, analyses of PAS data were based on patient days as well as separations. Another characteristic of the data was that a separation was accounted to the year in which the separation occurred, regardless of the date of admission. This recording practice could theoretically cause some distortion in the patient days. However, due to the non-systematic nature of this recording "error," its effect was assumed to cancel itself out.

The PAS data had a dynamic time flow element due to the continuous nature of separation observations. This was inherently different from the single time cross-sectional observations of the census data. The two data sets, PAS and census, therefore were not strictly compatible. The census data tended to represent an average of the persons present in the year because the census was taken near the middle of the year. The PAS data, on the other hand, were collected continuously over the year and could not be considered to represent the average. Such a discrepancy could theoretically jeopardize the validity of utilization rates calculated with 'incompatible' data. However, the actual effect of this data character discrepancy was likely to be only minimal. It was worthy of note in recognition of a potential source of error, particularly in areas with relatively high birth rates.

It should also be noted that three months of PAS data in 1979 were not available. Rather than use adjustment factors to restore longitudinal comparability, the researcher decided to use the twelve month, data continuous, period spanning March 1979 to March 1980. As a result, the following data year was also changed to span March 1980 to March 1981.

Age Boundaries

The hospital separations which were relevant to this investigation were abstracted from the general PAS files. The principal division was that of age. Pediatric separations were identified if the patient (excluding newborns) was under fifteen years of age on admission. The upper boundary of fifteen years was chosen on the basis of statistical convenience and data comparability. The census data, for example, were tabulated in 5 year age groups. Using a population based approach to utilization rates, it was therefore most convenient to use corresponding categories. Subdivision of the categories to accommodate other pediatric boundary points, such as age 16 or age 18, would have created major computational problems and introduced new sources of error. In addition, Statistics Canada used age 15 as the boundary for its morbidity and utilization statistics, as did several publications from the United States (Andersen Co. et al., 1978; U.S. Department of Health and Human Services, 1982). To allow comparisons with utilization statistics from other sources, the apparent convention of the age 15 boundary was adopted for this investigation. It should be noted, however, that the clinical practice of pediatric medicine would not be limited by such an arbitrary boundary. Newborns were excluded because, strictly speaking, they are typically not the patients, the mothers are. In addition, it was assumed that patterns of utilization for newborns would be influenced primarily by the determinants of obstetrical service utilization.

Diagnostic Categories

Disease specific utilization rates were based on selected diagnostic categories. These categories were selected on the basis of several criteria. The goal was to select categories which 1) had relatively stable coding patterns over the study period, 2) were representative of pediatric illnesses and special care needs, and 3) represented sufficient number of cases so as to avoid unstable rate estimates based on rare events.

The condition of coding stability was difficult to satisfy. The system used to code primary diagnoses was changed three times during the study period. From 1971 to 1973 the system titled Hospital Adaptation of the International Classification of Diseases (H-ICDA) was in effect, and from 1974 through 1978 a revised edition (H-ICDA-2) was used (Statistics Canada, 1092a, p. 10). A completely revised system came into effect in 1979 (C.P.H.A., 1981, p. 27). It was titled International Classification of Diseases-Edition 9-Clinical Modification (ICD-9-CM). Each coding system modification was intended to replace the previous edition. Comparability of the coding systems over time was therefore not guaranteed. Fortunately, however, there was a relatively stable superstructure of very broad diagnostic categories. It was primarily the codes within the broad groupings which tended to vary with each new edition. The task of selecting diagnostic categories became one of choosing a set of categories which was specific enough to be meaningful yet broad enough to remain relatively stable over time.

The representativeness of a diagnostic category was determined through consultation with a practicing pediatrician. Commonly occurring pediatric diagnoses were favored for selection along with those which required relatively specialized pediatric services. The following diagnostic categories were selected: 1) intestinal infections, 2) strabismus, 3) otitis media, 4) acute upper respiratory tract infections and influenza, 5) pneumonia, 6) asthma and bronchitis, 7) tonsillitis, 8) hernias, 9) congenital heart anomalies, 10) other congenital anomalies, 11) perinatal disorders, 12) skull fractures, 13) other fractures, 14) laceration, 15) burns, and 16) poisonings. (See Appendix B for detailed listings of associated codes.)

Geographic Unit of Analysis

Comparisons of area specific utilization patterns and analyses of patient movement patterns all required that the province be divided into mutually exclusive and exhaustive geographic units. Several systems for geographic subdivision were examined; municipalities, census tracts, and hospital districts. Desirable characteristics for the unit of analysis included; 1) comparable size in terms of geographic area, 2) comparable population characteristics, 3) inclusion of only one hospital per unit, and 4) relative stability of boundaries over time. None of the existing subdivision systems satisfied all the desired characteristics. The hospital district however was considered the most appropriate compromise based on the following rationale. Districts were large enough to reduce data volume and yet were small enough to minimize the averaging effect of reducing the data. The PAS separation abstracts recorded hospital districts for geographic coding of the patient origin. Using the same system for this investigation prevented a cumbersome and potentially error ridden translation process. Census data, collected in relatively small enumeration areas, could be compiled to approximate district boundaries. Finally, all but eight of the 102 districts included only one hospital. The following districts (number of hospitals in brackets) were the exceptions; Edmonton (6), Calgary (6), Lethbridge (2), Bonnyville (2), Beaverlodge-Hythe (2), Fort Vermilion (2), Lamont-Mundare-Willingdon (3), and Flagstaff-Hughenden (4). There would have been fewer exceptions had it not been necessary to combine certain districts which were currently separated. Districts which had been combined at any time during the study period had to be considered as combined throughout the study period for the sake of longitudinal comparability.

One of the desirable characteristics was significantly compromised by the choice of hospital district. Districts were not comparable in terms of geographic dimensions. Northern hospital districts in particular covered huge expanses of territory relative to districts in the center of the province. Equivalent dimensions would have been desirable so that atypical patterns of patient flow could be attributed primarily to varying levels of service provided by different hospitals or to referral patterns. With wide variation in dimensions and transportation systems, however, flow patterns are likely to be shaped and/or distorted by time and distance considerations regarding travel.

3.2.3 Provincial Annual Reports

The Annual Reports and accompanying statistical supplements issued by the Department of Hospitals and Medical Care (DHMC) provided supporting data for this investigation. Such data included; 1) the number and size of general hospitals in the province, 2) pediatric bed complements for each hospital, and 3) changes in hospital district boundaries over time. It should be noted that from 1971 through 1977 responsibility for provincial hospitals was accorded to the Alberta Hospital Services Commission. The Commission issued annual reports which covered the calendar years from 1971 through 1976. In 1977, the reporting structure was changed to a fiscal year in preparation for the transfer of responsibility to the newly formed DHMC in January 1978. The reporting system transition resulted in the 1977/78 "annual" report covering a fifteen month period between January 1, 1977 and March 31, 1978.

3.3 Analytical Steps

The analyses of pediatric utilization in Alberta were divided into five steps which corresponded with the investigational objectives. The first step was, therefore, to identify the provincial levels of general and disease specific utilization of acute hospitals, and the associated trends over time. The second step was to compare district utilization rates, across the province and over time, so as to identify any consistent patterns of rate variations. The third step was to aggregate districts into regional areas, and compare the associated regional utilization rates over time and diagnoses to identify any systematic patterns of regional utilization. These first three steps were designed to explore patterns of hospital use by children in relation to three major determinants of utilization; disease or diagnosis, time (a proxy for changing patterns of practice and technology), and location of residence. As such these analytical steps addressed the first, second and fourth investigational objectives.

The fourth analytical step was to explore patterns of hospital use, through patient-origin destination studies, in relation to three other determinants of utilization; referral patterns as evidenced by patient movement, levels of service available, and intensity or complexity of illness. This step addressed the third and fourth objectives. The fifth and final analytical step was to apportion pediatric utilization by levels of care in order to provide a qualitative evaluation of pediatric utilization of hospitals in Alberta. Through this step, the fifth investigational objective of estimating the level of utilization for tertiary level pediatric care was addressed.

A more detailed description of methods employed in the analytical steps are presented in the following five subsections.

3.3.1 Provincial Analysis

The three primary measures of utilization were first examined in their raw form of total separations, total patient days and average length of stay. These figures were obtained by aggregating utilization data over all hospitals and over all districts in the province. The raw measures were examined for each diagnostic category, for all diagnoses combined, for each of the ten years, and for all years combined. The entire pediatric service population and its various age and sex subpopulations were subjected to this analysis.

Raw measures were then converted into provincial utilization rates. The denominators used in the rate calculations were annual provincial service population figures. Numerators were either total provincial SEPS or total provincial DAYS. Rates were calculated for each diagnostic category, for all diagnoses combined, for each of the ten years and for all ten years combined. Rates for specific diagnostic categories and for pediatric hospitalizations in general were then examined for any patterns or trends in utilization over time. In addition, an attempt was made to compare the Alberta rates with corresponding statistics for Canada and the United States. Such comparisons were made to help view the Alberta experience in a broader context, and to provide a frame of reference in the absence of absolute or normative standards for pediatric utilization rates.

3.3.2 District Analysis

The next phase of the investigation was to examine the variability of district rates across the province and to identify rate variations among geographic areas. The conceptual foundation for this analysis was provided by Bay & Nestman (1984), Griffith et al. (1981), and Shaughnessy (1982) through their discussions of the community based (CB) method for deriving utilization rates. The CB method required that the study area be subdivided into smaller geographic units which were relatively homogeneous with respect to their determinants of utilization. The geographic unit of analysis for this analytical step was the hospital district. Therefore, utilization rates, in terms of SEPS and DAYS for all diagnostic categories, were calculated for each hospital district. Rates were calculated for years 1971, 1976, and 1980/81 to allow identification of any historical trends. It was felt that the three years would be sufficient to reveal basic trend directions over time.

The volume of information generated by two rates for each district (102), for each disease category (17 including the total), for three years amounted to nearly ten thousand units of information. Thus, in order to assess district rate variability, the district rates were treated as a distribution of observations. Rate distributions were then examined for the minimum and maximum rates and the distributional skew. The Edmonton and Calgary district rates were isolated as landmarks in the distribution because together they represented the rates applicable to, or collectively experienced by, 52% of the service population. Rate trends within other individual districts were considered to generally have a limited impact on the pediatric health service system and were, therefore, not pursued more aggressively.

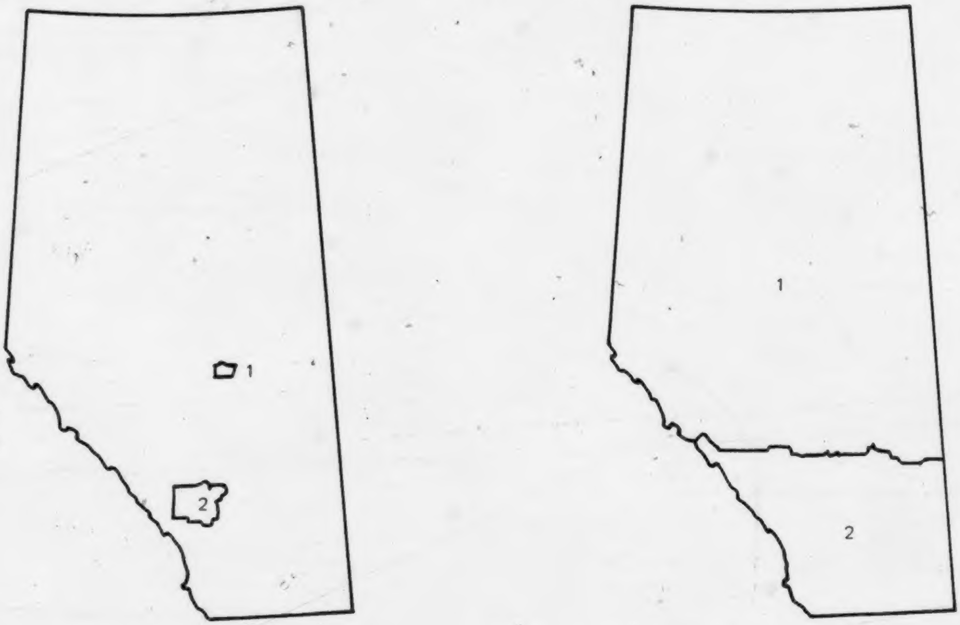
The geographic variation in district rates was examined by mapping rates according to categories devised to represent rates on a relative scale (i.e. low, moderate, high). The relative scale was based on percentage variation from the provincial rate. Rate mapping was only undertaken for data combined over the ten years.

3.3.3 Regional Analysis

Following the analyses of utilization rates for hospital districts, the CB analysis was extended to an examination of rates for clusters of districts, and limited to an examination of ten or less diagnostic categories. Diagnostic categories were combined or deleted on the basis of the researcher's judgement of the investigative value of maintaining each category separately. The district analysis was the main source of information for this judgement. The clustering of districts was based on the patient origin-destination studies and experience of several other researchers who had examined regional utilization rate variations in the Alberta health care field. Paine and Wilson (1975) clustered areas (census subdivisions) which had similar roles as regional referral centers for acute care in Alberta. These centers included Edmonton, Calgary, Grande Prairie, Lethbridge, Medicine Hat, and Red. Deer. Toll (1982) clustered hospital districts by the highest level of care (primary, secondary, or tertiary) available within the district. The clusters could roughly be described as metropolitan areas, regional areas, and rural areas. MacDonald (1982), in a study of

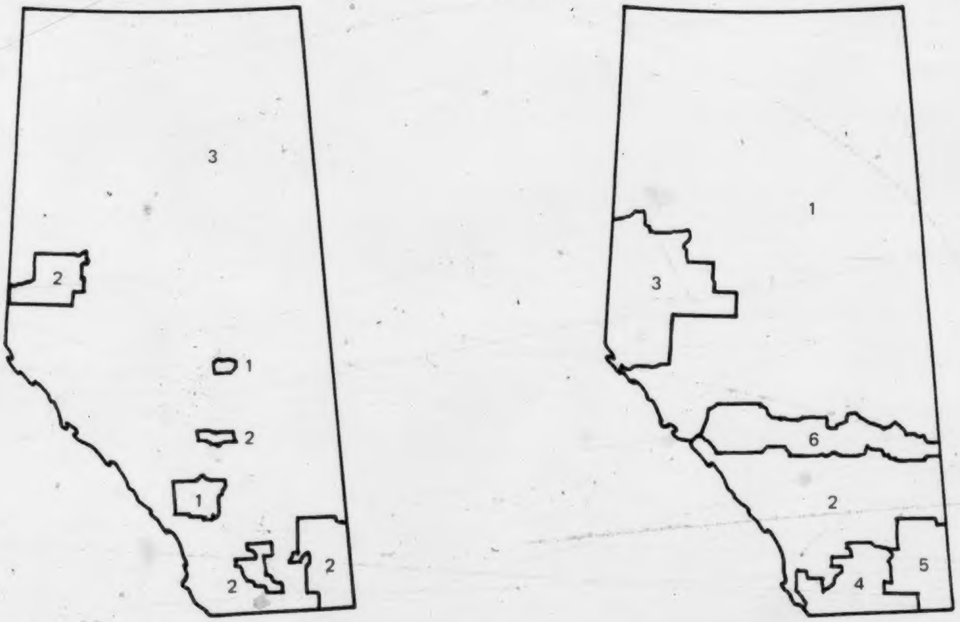
FIGURE 2

DIAGRAMS OF FOUR DISTRICT AGGREGATIONS



MAP A 1) METRO - EDMONTON
2) METRO - CALGARY

MAP B 1) NORTH
2) SOUTH



MAP C 1) METROPOLITAN AREAS
2) REGIONAL AREAS
3) RURAL AREAS

MAP D 1) EDMONTON REGION
2) CALGARY REGION
3) GRANDE PRAIRIE REGION
4) LETHBRIDGE REGION
5) MEDICINE HAT REGION
6) RED DEER REGION

surgical service utilization, clustered hospital districts according to their similarities or dissimilarities with respect to determinants of surgical utilization. She was able to demonstrate, through these different clusters, that rate variations were in part dependent upon the geographic areas chosen for study.

Based on the above research experience in the examination of variations in regional utilization patterns, hospital districts were aggregated into four clusters or regions. The aggregation regions are depicted in Figure 2. Descriptions and rationale for the aggregations are presented in the following sections.

Map A: Metro-Edmonton and Metro-Calgary

The format of regional comparison in this "aggregate" was in fact only based on two separate, albeit heavily populated, districts; Metro-Edmonton and Metro-Calgary. Most determinants of pediatric utilization related to availability of service, socio-economic conditions, and disease prevalence were assumed to be similar within these two districts. Utilization rates were therefore expected to be similar.

There was one notable difference between the two districts. MacDonald (1982) had noted the size difference between the two metropolitan hospital districts. In recognition of the influence of distance and travel time on patterns of use, MacDonald's comparisons grouped four surrounding suburban districts with the Metro-Edmonton district. The risk inherent in that cluster was the addition of areas which could have dissimilar patterns of pediatric affiliation determinants. The clustering could therefore have detracted from, rather than enhanced comparability.

For this investigation the two metropolitan districts were unaltered for three reasons. First, the suburban districts had satellite pediatric service systems of their own which could shape patterns of use much different than those in metropolitan areas. Second, due to methodological complexities, little attempt was made to ensure that regions for the other aggregations were of equivalent size. Thus, there was no reason to make it an "issue" for one aggregation. Finally, it was felt that considerations of travel time to service locations would not, in fact, significantly influence utilization rates for either district. (Distance might however influence patterns of use with respect to specific hospitals within the districts).

Map B: North and South Regions

Health service delivery in Alberta seemed to be naturally polarized into north and south referral regions. The polarization was consistent with the north-south relationship of the two major metropolitan/referral centers. Because these two super-regions are often compared with respect to equitable resource division within the province, it was felt that a north-south comparison of utilization patterns would be of interest. Due to the large area encompassed by each region, homogeneity of utilization determinants within regions was not expected. However, the variability of determinants could be assumed to be similar. Both regions, for example, included rural, urban, and metropolitan centers. Utilization determinants would likely vary among the centers but probably vary to a similar degree in both regions. On this basis, the two regions were considered to be comparable.

The boundary between the two regions was determined on the basis of generalized provincial utilization patterns reported in previous utilization studies (Toll, 1982 and MacDonald, 1982) and patterns of pediatric patient flow across the demarcation line. The boundary was assumed to represent the natural division of patient flow patterns such that persons living north of the demarcation line would be more likely to travel to the northern referral center while persons living south of the line would be more likely to travel to the southern referral center, should their health care needs require services of a major center.

Map C: Metropolitan, Regional and Rural Areas

In the previous two aggregations, new regions for comparison were constructed and assumed to be relatively equivalent in terms of the distribution and/or variability of utilization determinants within their boundaries. A different approach was to compare utilization measures among dissimilar regions. Comparisons of this nature could provide insight into the influence of dissimilar utilization determinants on the variations among utilization rates. It was felt that one appropriate basis for comparison would be varying levels of urbanization. Hospital districts were therefore categorized into three groups; metropolitan, regional (or urban), and rural. The metropolitan group was comprised of the Metro-Edmonton and Metro-Calgary districts. The regional group included the districts which corresponded to the urban centers of Grande Prairie, Lethbridge, Medicine Hat, and Red Deer. The rural group contained the remaining districts. The resulting aggregation was similar to aggregations used by Toll (1982) and MacDonald (1982).

It was assumed that the variability of utilization determinants was greater between and among the groups than it was within the groups. Variation of utilization rates was, therefore, anticipated among these groups. The extent of variation, beyond that which was likely due to stochastic variation in utilization patterns, would not be explored however due to statistical complexities which were beyond the scope of this thesis.

The metro-regional-rural classification was chosen due to its relevance to regional patterns of service availability. Conceptually, health care delivery systems can often be subdivided into primary, secondary, and tertiary services; the primary services providing the basic, first line care on a local level, the secondary services providing somewhat more specialized care for a regional catchment area, and the tertiary services providing highly specialized and technical care on a referral basis to large regional areas. This conceptual classification is consistent with the ecological approach to categorizing health services (Roemer, 1979; Shonick, 1976; Anderson & Wertz, 1977; and Morrill & Erickson, 1968). According to this conceptual model tertiary services are characteristically centralized in major urban or metropolitan centers, secondary services in smaller urban centers, and primary services in outlying rural areas (Trivedi, 1978; Toll, 1982). These conceptual divisions however represent levels of a watershed type, tri-level hierarchy rather than mutually exclusive categories. The successively inclusive levels of care exist such that metropolitan centers, for example, would provide primary, secondary and tertiary care to metropolitan residents, secondary and tertiary care to residents of surrounding communities, and tertiary care to residents from a distance away. From the community perspective, metropolitan residents would have all levels of care (primary, secondary, and tertiary) available within their home district, regional residents would have only primary and secondary levels of care available within their district while residents of rural areas would have only primary care available within their home districts. Comparisons of utilization rates for residents of metropolitan, regional and rural areas were, therefore, expected to provide some insight into the influence of the level of care available on rate variations.

Map D: Edmonton, Calgary, Grande Prairie, Lethbridge, Medicine Hat, and Red Deer Regional Areas

Two of the preceding aggregations (Map B and Map C) created relatively broad categories of districts. It was felt that a somewhat more detailed division of districts would also be valuable for comparisons. To this end, all hospital districts were categorized into six regional areas. Boundaries for the regions were chosen such that the majority of area residents would most likely seek acute pediatric health care within the regional boundaries (all six areas had secondary/regional service centers within their boundaries). The resulting regions were similar to those used in two previous utilization studies (Paine & Wilson, 1975; MacDonald, 1982). Three of the regions, Calgary, Lethbridge and Medicine Hat were situated in the southern referral region as described for Map B. The remaining three regions were situated in the northern referral area. The regional areas were otherwise dissimilar in terms of determinants of utilization, particularly with respect to travel time to secondary and tertiary care facilities.

3.3.4 Patient Origin-Destination Analysis

Origin-destination studies were undertaken to gain information regarding patient movement patterns from two perspectives; the community (district) perspective and the provider (hospital) perspective. The community perspective analysis would provide information regarding the movement of patients seeking care outside their community of residence. The provider perspective would contribute information regarding the movement of patients to a particular hospital (or group of hospitals). From the latter analysis, the degree to which a given hospital serves local residents or serves patients referred from other districts could be determined. Through this process, the market constituencies for a given hospital or group of hospitals could be identified.

Analyses up until this point had concentrated on the community perspective. Information from this perspective would be valuable for system level planning efforts. The origin-destination analysis was significant in that it allowed examination of utilization patterns from the providers' (hospital's) viewpoint. Information from this vantage would be valuable for planning within the system, such as the distribution of services within districts or regions.

Patient origin-destination matrices were developed according to the method described by Griffith (1972). The Statistical Package for the Social Sciences (Nie et al., 1975) was used to construct crosstabulation matrices from the large data files. The data files had been previously compiled from specially developed FORTRAN programs. The variable DIStricts (or cluster of districts) of patient residence served as the patient origin dimensions while the variable HOSpitals (or cluster of hospitals) of service delivery served as the patient destination dimension.

Matrices were generated in terms of both SEPS and DAYS for data which had been aggregated over the ten year study period. Data were aggregated in order to maximize stability of patient flow indices. There was evidence to suggest that if matrices were generated for individual years the number of SEPS or DAYS in each cell, for certain diagnostic categories, would not be large enough to assure accurate and stable patient flow measures. To obtain some view of changes in patient flow over time, a series of matrices was constructed in terms of all DAYS combined for the years 1971, 1976, and 1980/81. The aggregation of diagnostic groups provided sufficient numbers to assure relatively stable measures of patient flow.

Diagnostic categories were collapsed or rejected so that only four large categories were to be used for this analysis. There was one category for all diagnoses combined, and three disease-specific categories each representing either primary, secondary, or tertiary type diseases. Disease "types" were determined by reviewing the movement of rural patients with respect to specific diagnoses. The conceptual basis for this method of disease classification was provided by Anderson and Wertz (1977). Primary type diseases were typically treated in local, rural health care centers and only rarely referred to areas with higher levels of care. Tertiary type diseases typically required care outside the rural area, most often in tertiary care centers. Secondary diseases were often treated outside the rural area but would typically be referred to regional centers and only infrequently to metropolitan referral centers.

Patient flow measures calculated from the origin-destination matrices included relevance and commitment indices. Relevance indices measured the tendency of patients to remain within, or leave, their district of residence to receive pediatric care. These indices provided information from a district perspective. The commitment indices measured the tendency for a hospital to serve patients located within, or outside of, the district in which the hospital was located. These indices provided information from the hospital perspective. The following sections provide more detail on the analyses conducted from the two perspectives.

District Perspective

From the district perspective, patient movement was viewed relative to districts of residence. The relative relationships were described by proportions referred to as relevance indices. The proportions were based on all the children living in a district who had been hospitalized. Some children were hospitalized in their home district while others were hospitalized outside their home district. The proportions of all hospitalized children living in the district who had been treated in their home district, or conversely treated outside their home districts, were referred to as relevance indices (see Appendix C for details of calculation). Several measures of utilization, such as SEPS or DAYS could be used to estimate the proportions (Bay & Nestman, 1984). Relevance indices for this investigation were calculated for both SEPS and DAYS.

Several different matrix formats were developed to address different questions and issues related to patient flow. Hospital size, for example, was suggested in the gravity model (Meade, 1974) as a force which influenced patient movement. Based on the gravity model, it was reasonable to expect that a district containing a large hospital would attract a relatively large number of patients residing outside the district and lose very few patients to other districts. A matrix was, therefore, constructed to examine the influence of hospital size on pediatric patient movement.

Districts were divided according to the number of rated beds in the district's largest hospital: A) 500 beds and larger, B) 100-499 beds, C) 50-99 beds, and D) under 50 beds. Category A represented districts with large hospitals with relatively strong power to attract patients. Category B, C, and D represented moderate, small and very small hospitals respectively, each with diminishing power to attract patients. Categories C and D could likely have been combined on the basis of limited ability to attract but were separated for this analysis only to distribute the districts more evenly among the categories.

The destination vector of hospitals was grouped according to the classification of the district they were situated in. For example, Calgary district was classified in category A, therefore, all Calgary hospitals were classified in a corresponding category A, regardless of their size. The four district and corresponding hospital categories were then crosstabulated to form an origin-destination matrix, subdivided into the four diagnostic composites, for all ten years of data combined.

Another matrix was constructed using the Map C Metro-Regional-Rural district categories. Although this matrix was similar to the hospital size matrix, it was conceptually different. The expected influence of hospital size in patient movement could be due to the relationship of hospital size and levels of care available. But, rather than accept hospital size as a proxy, the Map C configuration was used to examine patient movement relative to levels of care. The actual category divisions were also different. Only the hospital size category A and the Map C metropolitan category contained the same districts. Categories B, C and D did not repeat the Regional-Rural configuration.

Patterns of patient flow relative to regional areas were also examined by using the Map D aggregate for districts and hospitals. It was expected that each region would be essentially self-sufficient in terms of primary and secondary care (as represented by the composite diagnostic categories), and that the Edmonton and Calgary districts would be self-sufficient in terms of tertiary care. The patterns of interest would be patient movement into Edmonton and Calgary for tertiary care. It was expected that Grande Prairie region children would travel almost exclusively to Edmonton while Red Deer region children would travel either to Calgary or to Edmonton. The Lethbridge and Medicine Hat region children were expected to travel almost exclusively to Calgary. Such patterns of travel would have implications for planning facilities intended to serve the northern or southern portion of the province.

Hospital Perspective

From the hospital perspective, patient movement was viewed relative to service providers. The relative relationships were described by proportions referred to as commitment indices. The proportions were based on all children discharged from a given hospital (or group of hospitals). Some children were from the district in which the hospital was situated while other children were from other districts. The proportions of children discharged from a hospital who lived in the hospital's district, or conversely lived in another district were referred to as commitment indices (see Appendix C for details of calculation). Several measures of utilization, such as SEPS or DAYS, could be used to determine the proportions (Bay & Nestman, 1984). Commitment indices for this investigation were calculated for both SEPS and DAYS.

Several matrix formats were developed to address different questions related to patient flow. Of particular interest were flow patterns relative to the metropolitan hospitals, which together accounted for 47% of all the pediatric DAYS over the ten years. Edmonton hospitals were crosstabulated with: 1) Metro-Edmonton district residents, 2) residents of surrounding suburban districts--Fort Saskatchewan, Leduc, Devon, Stony Plain, and Sturgeon, and 3) residents of all other districts in the province. Calgary hospitals were crosstabulated with: 1) residents of the Metro-Calgary district and 2) residents of all other districts in the province. Each crosstabulation was done in terms of SEPS and DAYS for all ten years combined and for the four composite diagnostic categories.

The expected result was that the University of Alberta Hospital (UAH), the Cross Cancer Institute and the Charles Camsell hospital would have the three highest commitments to residents beyond Edmonton and its surrounding districts, regardless of the diagnostic category. Patterns of commitment were expected to change, however, when the composite diagnostic categories were examined separately. The Foothills Provincial General (FTH), the Alberta Childrens Hospital, and perhaps the Calgary General were expected to have the highest commitments to residents beyond Calgary. (The Calgary district was not surrounded by suburban districts as was the Edmonton district). Similarly, the patterns of commitment were expected to change with varying levels of disease complexity as represented by the composite diagnostic categories.

Another portion of the hospital perspective analysis was to examine patient flow relative to the levels of care available in different hospitals. To accomplish this the Metro-Regional-Rural aggregation was modified slightly. Instead of dividing hospitals into the three categories, the metropolitan category was divided into Referral hospitals and other Metropolitan hospitals. The referral centers, the UAH and FTH, were categorized separately because it was expected that the patterns of use for the referral centers could be markedly different from those of the other metropolitan hospitals. The expected pattern was that the Referral hospitals would have relatively large commitments to residents living outside the Calgary and Edmonton districts, particularly for the congenital disorders category. Metropolitan hospitals, on the other hand, were expected to be less heavily committed to residents of non-metropolitan districts.

The last portion of the hospital based analysis was an examination of patient movement relative to hospital location. The Map D configuration of six regions was used for this task. It was expected that hospitals would be primarily committed to residents of their own region, but that the level of commitment to other regional residents would change with varying disease complexity.

3.3.5 Levels of Care Analysis

This analysis was intended to help plan bed requirements for a consolidated facility for tertiary referral pediatric care in Alberta, should such a facility be deemed necessary and/or feasible by government policy. A consolidated facility would be required to provide all three levels of care to Alberta children, but from a planning perspective, costs and resource requirements would be most heavily influenced by the tertiary care needs. It was therefore important to estimate the level of pediatric utilization which could be attributed to tertiary level care. From such estimates, tertiary care resources and "needs" could then be examined in terms of bed equivalents.

A methodology for examining utilization by levels of care was pioneered by Toll (1982). The method was conceptually based on Anderson and Wertz's (1977) work in British Columbia but was later adapted and refined by Toll for her study of patterns of utilization in Alberta. It was Toll's method which was used in this analysis to apportion pediatric DAYS by levels of care. The method relies heavily on a set of assumptions regarding patient movement in relation to levels of care available. These assumptions were considered to be appropriate to the Alberta pediatric situation based on the results of the patient origin-destination analyses which were described in section 3.3.4.

The first step was to apportion all pediatric DAYS, regardless of disease, to the Metropolitan-Regional-Rural origin-destination matrix. This configuration was used due to the relationship of the categories to levels of care available to residents. It was then assumed that all pediatric DAYS which were attributed to Regional area residents but were accumulated in Metropolitan area hospitals could be attributed entirely to tertiary level care needs. If their care needs had been of a primary or secondary nature, it was reasoned, then the residents would have sought care in their own Regional area. In addition, it was assumed that the requirements for tertiary level care were the same for all Albertan children. Consequently, the level of tertiary care utilization, in per-capita terms, identified for Regional residents could be assumed to also exist for Metropolitan and Rural residents.

Rural residents' DAYS which were accumulated in Rural area hospitals were assumed to represent primary level care as no other level of care would have been available to residents in Rural areas. The level of Rural primary care utilization (in annual per-capita terms) was not considered applicable to Metropolitan and Regional areas. Instead, it was assumed that variations in utilization rates were due to variations in primary care requirements due to extra-medical factors such as climatic or geographic conditions. Primary care requirements for Metropolitan and Regional residents were therefore calculated as the variation in utilization levels which remained once secondary and tertiary levels of utilization were accounted for.

The level of secondary care utilization was calculated initially for Rural residents by subtracting the previously identified primary and tertiary care utilization rates for Rural residents from the known total level of Rural utilization. Once a secondary level care utilization rate was estimated for Rural residents, that rate was also attributed to Metropolitan and Regional residents under the assumption that secondary care requirements, as with tertiary care requirements, were the same for all Albertan children. Level of care utilization rates which were applied to areas by assumption could then be converted into estimates of apportioned DAYS by multiplying the rate by the area's service population. In this manner, utilization by levels of care could be examined in terms of DAYS and DAY rates for each area (Metropolitan, Regional, and Rural) and for the province as a whole.

Although DAYS were apportioned according to all three levels of care, the proportion of primary planning interest was that of tertiary care. To convert the tertiary care DAYS for Alberta's children into terms of bed requirements, the total tertiary DAYS for a given time period were divided by a theoretical capacity for that time period (i.e. 365 calendar days per year) and a loading factor (i.e. expected occupancy rate). Although the resulting figures were not actual forecasts of projected tertiary bed needs,they did provide a qualitative perspective to the examination of past utilization patterns which could be applied to future planning efforts.

Actual forecasts for tertiary care needs were not undertaken due to the substantial changes in the pediatric referral services since 1980/81. The Alberta Children's hospital, for example, opened 15 intensive care beds and an emergency service in the fall of 1982. The Royal Alexandra Hospital in Edmonton also expanded its neonatal intensive care unit during that time. Such changes were likely to have an impact on tertiary level utilization rates and patterns which could invalidate forecasts projected from 1980/81. A more appropriate forecast could therefore be made once utilization data from 1982 or 1983 became available.

3.4 Chapter Summary

The methodology used to explore patterns of pediatric utilization in Alberta was based on the planning process framework which included the following steps: 1) developing the research strategy, 2) acquiring and assessing data, and 3) developing steps for analyses. The overall strategy, which was developed in the first step, was to conduct the research from a descriptive, rather than an inferential perspective. Secondary strategies included: viewing utilization over time through the use of retrospective, rather than prospective, longitudinal data; examining utilization on a per-capita basis through the use of population-based utilization rates; and qualitatively differentiating utilization relative to intensity/complexity through the use of levels of care categories.

Data which were required included detailed hospital utilization files for Alberta residents from 1971 onward, detailed listings of the Alberta census population for the corresponding time period, and information regarding hospitals and hospital districts. All data were obtained from the Hospitals and Medical Care Department of the provincial government (including census data organized by hospital district). Limitations in the accuracy and timeliness of such massive data files were recognized and discussed. File modifications included the extraction of a pediatric subset from the census and utilization files, the identification of diagnostic subsets from the utilization files, the addition of population estimates for intercensal years, and the calculation and addition of service population data for each year (age-sex adjusted census population).

The actual analytical pathway was divided into five steps which were designed to achieve the investigational objectives. The first three steps examined patterns of pediatric utilization in Alberta from provincial, district, and regional levels of aggregation. The regional level of analysis was modified in the fourth step to examine patterns of patient movement from both the community-based and provider based approaches. Then,the final step used the patterns of patient movement to estimate the proportion of utilization which could be attributed to tertiary level care.

CHAPTER IV

RESULTS

Findings of the investigation are discussed in a sequence which parallels that of the analytical pathway outlined in the previous chapter. The chapter is therefore divided into five major sections: 1) provincial pediatric utilization trends, 2) comparisons of district pediatric utilization rates, 3) regional variations in pediatric utilization rates, 4) patient origin-destination flow patterns, and 5) estimates of tertiary level care utilization. In keeping with the investigational perspective, the results are primarily descriptive. In order to frame these descriptive results within a meaningful context, a profile of the Alberta health care system is presented in an introductory section.

4.1 Alberta Health Care System

The profile is intended to outline systemic factors which could influence utilization patterns and their changes over time. Reviewed aspects include structural components such as districts, hospitals, and beds, and dynamic components such as physicians and service populations.

Hospital districts divide the province into 103 mutually exclusive and exhaustive administrative regions. The geographic size and shape of the districts varies markedly, as does the population size within the districts. In general, the sparsely populated northern areas of the province are divided into hospital districts with relatively large land areas. Conversely, the more densely populated areas of the province, along the Highway 2 central corridor, are divided into hospital districts with relatively small land areas.

The uneven distribution of population and land area among hospital districts has several implications for utilization studies. With large variations in population size, for example, districts are likely to be dissimilar in terms of social support networks and concentrations of health service resources. Direct comparison of utilization rates among districts with such "dissimilar" determinants of utilization could therefore be misleading, unless the "dissimilarities" are recognized. With large variations in district land area, travel distance and/or time from residence to hospital is likely to be highly variable. As noted in the literature review, there is evidence to suggest that such travel factors can be important determinants of utilization. Assuming this relationship holds true for pediatric utilization, any variation of utilization rates among districts or regions could conceivably be due, in part, to travel factors.

Hospitals are distributed relatively evenly among the hospital districts, typically, with one hospital per district. Three districts however have no hospital, and ten districts (primarily urban areas) have more than one hospital. In 1971 there were 123 general hospitals, four of which were under federal jurisdiction. By March 1981, there were 124 general hospitals, two of which were federal. During that time the Rockyview/Holy Cross became two separate institutions and two federal hospitals changed to provincial jurisdiction. In terms of pediatric care, there is one hospital dedicated solely to children--the Alberta Children's Hospital in Calgary.

As expected from the variations in the hospital district population sizes, the number of hospital beds are not evenly distributed across the province. In 1979/80, nine major metropolitan hospitals contained approximately 51% of all the acute care beds in the province. In contrast, 17% of hospital beds were distributed among 72 small hospitals, each of which had less than 50 beds. Pediatric beds were apportioned such that 39% of the beds were located in the nine metropolitan hospitals and 20% of the beds were distributed among the 72 rural hospitals (Department of Hospitals and Medical Care (DHMC) 1980). These proportions have remained relatively stable over the ten year study period.

Between 1971 and 1979/80, the total number of acute care beds increased by approximately 4% (509 beds). The largest increase was experienced in Edmonton hospitals which added 439 beds during the nine years. In contrast, pediatric beds in the province declined by almost 11% (207 beds) over the same period. The largest decline was experienced in Edmonton hospitals which lost 112 pediatric beds. Consequently, the proportion of pediatric beds to total acute care beds has declined from 16.7% in 1971 to 14.3% in 1979/80 (Alberta Hospital Services Commission, 1971; DHMC 1980). In the Edmonton hospitals the proportion of pediatric beds dropped from 16.2% (583 beds) in 1971 to 12.8% (471 beds) in 1979/80.

When summary statistics for hospital utilization in Alberta were compared with national statistics, it appeared that Alberta traditionally had slightly more than the average number of beds per person; Alberta with 5.6 beds per 1000 persons in 1981 as compared to Canada's 5.1 beds per 1000 persons. (Statistics Canada, 1982b). Pediatric bed comparisons were only available as percentages of total hospital beds. As such, Alberta had the second largest proportion of pediatric beds (13.7%). Saskatchewan had the highest (14.7%) and Quebec the lowest (6.2%). The proportion of pediatric beds over all of Canada was 8.9% (Statistics Canada, 1981). Caution would be advised, however, in the interpretation of these proportions and their extreme variations across the country. The variations could be a function of the inclusion of various types of hospitals, such as auxiliary or rehabilitative, in these statistics.

The total number of medical practitioners in the province increased approximately 26% from 1973 to 1981 (MacDonald, 1982). Corresponding statistics were not available for 1971 and 1972. General practitioners contributed at least 50% of the total number of physicians during that time. Pediatricians constituted approximately 4% of the total number of physicians during the years from 1979 to 1981. Physicians were typically concentrated around the Edmonton and Calgary areas (DHMC Health Care Insurance Plan, 1981). In 1981, 76% of all the medical practitioners were located in the Edmonton and Calgary regions (regional areas were different than those described for this investigation). This cluster of physicians included approximately 87% of all specialists and 68% of all general practitioners in the province.

The population of Alberta grew from 1.63 million in 1971, to 1.84 million in 1976, and to 2.24 million in 1981 (Statistics Canada 1973, 1978, 1983). In terms of percentages, the Alberta population increased by 12.9% between 1971 and 1976, and by 21.7% between 1976 and 1981, with a total increase from 1971 to 1981 of 37.4%. The Alberta pediatric population (under age 15) increased by only 5.4% during the same time period. The growth was not, however, a gradual upswing. Instead, the pediatric population decreased by 2.1% between the 1971 and 1976 census years and then increased by 7.6% between the 1976 and 1981 census years (see Table 1). The overall decrease between 1971 and 1976 was heavily influenced by a decrease of 9.7% in the 5-9 age group; the children of the early 1960's. From 1976 to 1981 the overall increase was largely due to a 27.9% increase in the under one year age group. During the same time, the depression in the age 5-9 pediatric population apparently passed on to the next age group. The 10-14 year age group declined by 4.1%, from 1976 to 1981 while the other pediatric age group populations increased substantially. The pediatric population was consistently composed of slightly more than 51% males in each age category.

Geographic distribution of the pediatric population has remained relatively stable over the years. Edmonton and Calgary together accounted for approximately 50% of the pediatric population in the 1971 and 1976 census years. This proportion dropped slightly, to 48% in the 1981 census. The secondary urban areas such as Grande Prairie, Lethbridge, Medicine Hat, and Red Deer, contributed 8.7% of the total pediatric population in 1971. This proportion increased slightly in 1976 to 9.2% and in 1981 to 9.8%. There were four areas of notable population change in the province. Fort McMurray experienced an economic boom during the study period which was reflected by a

Table 1

Alberta Pediatric[1] Population and Percent Change by Age Group for Census Years 1971, 1976, and 1981.

Age Group	Census Year			Percent Change	
	1971	1976	1981	1971-1976	1976-1981
under 1	30100	31395	40170	4.3%	27.9%
1-4	120860	121625	147850	0.6%	21.6%
5-9	180745	163125	174090	-9.7%	6.7%
10-14	182320	187275	179535	2.7%	-4.1%
Total	514025	503420	541645	-2.1%	7.6%

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[1] Pediatric denotes under 15 years of age.

158% increase in the pediatric population from 1971 to 1981. Stony Plain experienced a 108% increase, while Leduc and St. Albert experienced an increase of 75% each over the ten years.

Age distribution within each district was indirectly examined by comparing the census population and the service population for each district. If, for example, the service population (equivalent to the age-sex adjusted census population) was larger than the census population, a relatively young pediatric population was suggested. The weighting factors used for the age-sex adjustments were larger for the younger age groups because they were more likely to utilize health services than the older age groups (see Appendix A, Table A.2). The under one year age group had the largest adjustment factor. Thus, districts with relatively large numbers of young children, particularly under one year, would have large age-sex adjustment weights and, therefore, larger service populations.

An examination of census to service population ratios (see Table 2) demonstrated the variation in age-sex composition of districts, and the population, over time. The existence of such variation indicates the importance of adjusting the census population figures. In 1971, 39 of the 101 districts had pediatric service populations which were within plus or minus 5% of their respective census populations. These 39 districts, however,

Table 2

Ratios of District Service Populations to District Census Populations for 1971, 1976, and 1980.

Ratio Range	1971		1976		1980	
	#Dists[1]	%SP[2]	#Dists	%SP	#Dists	%SP
1.15 or more	0	0.0	0	0.0	1	0.2
1.05 to 1.15	5	2.1	14	5.3	27	67.1
0.95 to 1.05	39	72.5	50	83.9	69	32.1
0.85 to 0.95	51	24.0	35	10.5	3	0.5
0.85 or less	6	1.4	2	0.3	1	0.1
Total	101	100	101	100	101	100

[1] abbreviation for number of hospital districts.

[2] abbreviation for percentage of provincial service population.

represented 72% of the provincial service population. Only 5 districts had "relatively young" pediatric populations. These districts represented only 2% of the provincial service population. In 1976, 14 districts, together representing 5% of the provincial service population, had "relatively young" pediatric populations. By 1980, 27 districts had "relatively young" populations but these districts represented 67% of the provincial pediatric population. Over the study period, the number of districts with relatively young populations was increasing as was the proportion of the service population which was represented by those relatively young districts.

4.2 Provincial Pediatric Utilization Trends

An examination of provincial pediatric utilization measures was conducted for each year and all years combined on two levels of aggregation: 1) one group containing all the pediatric cases, and 2) sixteen groups of diagnostic specific pediatric cases. Comparisons were made among age groups, among sexes, and across years. Some comparisons were stated in terms of the raw measures of utilization: 1) separations (SEPS), 2) patient-days (DAYS), and 3) average length of stay (ALOS). Utilization rates were also used to provide comparisons which were adjusted for the effects of population size and age-sex composition.

4.2.1 Utilization for All Diagnoses Combined

Three raw measures of utilization (SEPS, DAYS, ALOS) were examined, for all pediatric hospitalizations, for each of the ten years between 1971 and 1980/81. The peak year for all three indicators was 1972. From 1972 to 1980/81, pediatric utilization declined steadily: SEPS decreased by approximately 25% while DAYS decreased by 40% and ALOS dropped from a high of 6.4 days to 5.1 days (20%). Males consistently contributed more than half of the SEPS and DAYS. The sex differential was most pronounced in the under one year age group (57.4% of SEPS and 57.1% of DAYS) and seemed to decline with increasing age. This pattern was evident in all ten years. Children under the age of one consistently accounted for more than 25% (and as much as 35% in 1980) of the total pediatric DAYS even though they composed only 6 to 7.5% of the pediatric population. In comparison, the 1-4 year old age group, with approximately 25% of the pediatric population, contributed an average of 32% of all the DAYS over ten years. Patients in the 5-9 year and 10-14 year age categories, each with roughly 33% of the population, each contributed approximately 19% of the total pediatric DAYS. Over time, the proportion of DAYS contributed by each age category paralleled the Canadian national trend of increasing patient days for children under one year and decreasing patient days for children of ages one through fourteen (Ouellet, 1979).

Provincial utilization rates for all pediatric SEPS and DAYS declined substantially from the peak in 1972 to the lowest level in 1980/81. The 1972 SEP rate was 159 separations per 1000 children (age-sex adjusted) while the 1980/81 rate was 107 separations per 1000 children (see Figure 3). Similarly, the 1972 DAY rate was 958 patient-days per 1000 children while the 1980/81 rate was 543 days per 1000 children. Thus, the decline noted above during examination of raw utilization measures was not due to changes in composition of the pediatric population. Alternatively, some other change or changes in the determinants of pediatric utilization, such as a reduction in bed availability, must have shaped the decline in hospital use over time.

The decline in Alberta pediatric SEP and DAY rates was in keeping with the decline, albeit less pronounced, for SEP and DAY rates for the total Alberta population (see Table 3). In fact, between 1971 and 1978 the SEP and DAY rates for the Canadian population were also declining. More specifically the Canadian pediatric (under age 15) rates were also dropping from 112.1 separations per 1000 in 1971 to 97.7 separations per 1000 in 1978 and from 758.3 patient days per 1000 in 1971 to 553.5 patient days per 1000 in 1978. Direct comparisons of Alberta and Canadian pediatric rates were limited

FIGURE 3

SEPARATION RATE PER 1000 CHILDERN - YEAR FOR ALL DIAGNOSES COMBINED, BY YEAR

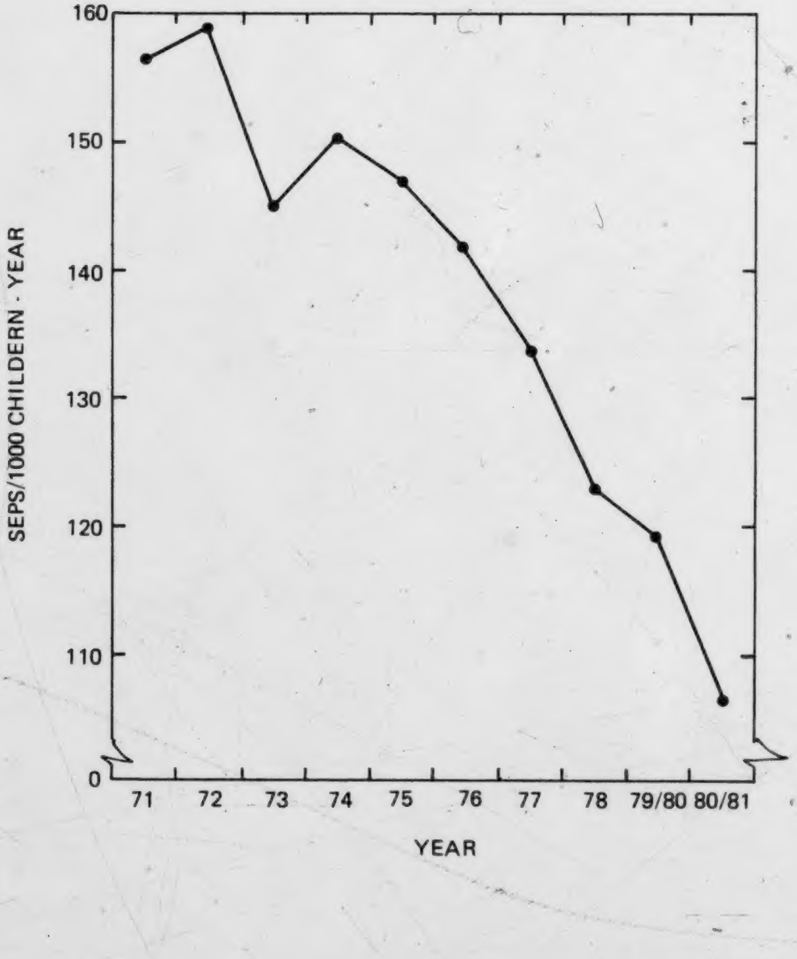

Table 3

Comparison of Albertan and Canadian Indicators of Hospital Utilization for the Total Population and the Pediatric Population from 1971 to 1978[1]

Indicators	1971	1972	1973	1974	1975	1976	1977	1978	% Change
Alberta									
SEPS/1,000 pop-yr[2]	222.0	216.8	209.5	215.6	202.4	201.6	191.5	187.0	-15.8
DAYS/1,000 pop-yr	2254.7	2429.7	2409.9	2368.9	2296.9	2140.5	2004.0	2074.3	-8.0
DAYS/SEPS	10.3	11.2	11.5	11.0	11.0	10.6	10.5	11.1	8.8
SEPS/1,000 child-yr	156.5	158.9	145.0	150.7	147.1	140.2	134.4	122.8	-21.5
DAYS/1,000 child-yr	957.7	1020.3	884.1	911.7	862.0	814.7	751.1	660.3	-31.0
DAYS/SEPS	6.1	6.4	6.1	6.0	5.9	5.8	5.6	5.4	-11.5
Canada[3]									
SEPS/1,000 pop-yr	165.9	166.7	167.5	165.8	161.6	157.8	154.5	152.0	-8.4
DAYS/1,000 pop-yr	1916.1	1927.6	1886.0	1867.7	1799.0	1725.9	1722.5	1597.2	-16.6
DAYS/SEPS	11.6	11.6	11.3	11.3	11.1	10.9	11.2	10.5	-9.5
SEPS/1,000 child-yr	112.1	109.7	108.9	108.2	103.8	100.4	99.2	97.7	-12.8
DAYS/1,000 child-yr	758.3	732.4	696.3	678.1	625.6	572.1	552.3	553.5	-27.0
DAYS/SEPS	6.8	6.7	6.4	6.3	6.0	5.7	5.6	5.7	-16.2

[1] Data were not available for 1979 or 1980.

[2] Source: Statistics Canada catalogues 82-206, Table III, 1976 and 1978.

[3] Source: Statistics Canada catalogues 82-206, Table VIII, 1971 to 1978.

however in that the Alberta data were specific to acute care hospitals while the Canadian data included all types of hospitals. In general however, the declining trend in pediatric SEP and DAY rates observed in Alberta was consistent with the Canadian pediatric experience and was likely part of an overall trend towards declining rates for the population as a whole.

4.2.2 Utilization by Diagnostic Specific Categories

The sixteen selected diagnostic categories accounted for 67% of the sum total of SEPS over ten years and 63% of all DAYS over the same period. These proportions changed over time, but not greatly. Five of the diagnostic categories consistently contributed a minimum of 5% each to the annual total of SEPS:

1) acute respiratory infections and influenza--14 to 15%,
2) tonsillitis--9 to 15%,
3) pneumonia--6 to 11%,
4) intestinal infections--7 to 8%, and
5) asthma and bronchitis--5 to 6%.

The other eleven categories together contributed the remaining 20 to 25% of the annual total SEPS. (Corresponding proportions for DAYS were very similar.) The relative contributions of categories varied over time. The contributions of the tonsillitis category to total SEPS, for example, dropped 66% in ten years. During the same period, the relative contribution of the perinatal category dramatically increased by a factor of six. A more detailed examination of variations over time will follow.

The distribution of SEPS and DAYS over age and sex groups varied characteristically among the diagnostic categories. In eight of the categories, the 1-4 age group contributed a greater percentage of SEPS than did the other age groups. These categories included: otitis media, hernias, strabismus, burns, poisonings and the three respiratory disease categories. For intestinal infections, perinatal disorders and congenital heart anomalies, the under one year age group contributed the greatest percentage of SEPS. For the tonsillitis category, the 5-9 age group contributed the greatest percentage of SEPS while the trauma related categories of skull fracture, other fracture and lacerations were dominated by SEPS from the 10-14 year age group.

The proportion of intestinal infection SEPS attributed to the under one age group was larger than expected in view of the group's relatively small contribution to the pediatric census population (7.4% in 1981), and the tendency for intestinal infections to commonly affect older children as well. It appears that the large proportion of SEPS reflected the greater risk of dehydration and electrolyte imbalances requiring hospitalization in younger children. The category of general congenital anomalies was not, as expected, composed primarily of younger children. Instead, the SEPS were distributed evenly among the under one, 1-4, and 5-9 age groups, with a small number of SEPS in the 10-14 age group.

In all the disease categories, at least 50% of the SEPS were attributed to males. In seven categories males contributed over 60% of the SEPS. These categories included: asthma and bronchitis, hernias, congenital anomalies, burns, and the three trauma related categories. Proportions in excess of 60% were higher than would be expected from the census population figures (51% males, under 15 years old, for 1971, 1976, and 1981). However, males were predisposed to some of the diseases/conditions. The male inguinal anatomy, for example, is relatively vulnerable to hernia development. It was, therefore, not surprising that males contributed 79% of the SEPS in the hernia category. The tendency for males to participate in physically active play and contact sports could explain, in part, the relatively high proportion of male SEPS in the trauma related categories, particularly in the older age groups.

An examination of SEP rates (separations per 1000 children-year) was undertaken to compare utilization among categories over the years while adjusting for the effects of the population age-sex composition. The SEP rates for each year and for the ten years combined are presented in

Table 4. As can be seen from the table, acute respiratory infections had the largest SEP rate over the ten years at 20.2 separations per 1000 children-year. The high rates likely reflected the common incidence of such illnesses, and the breadth of illnesses which could be subsumed under the category. The rate variation over time followed the general trend of peaking in 1972 and declining rapidly to the lowest value in 1980/81. Pneumonia followed a very similar pattern. The most dramatic decline was seen for tonsillitis SEPS; a total decrease of 60%. This change was consistent with the national trend of declining tonsillectomies (MacDonald, 1982). Only two SEP rates demonstrated a net increase over the ten years: congenital heart anomalies and perinatal disorders. The perinatal SEP rate rose dramatically from 0.4 in 1971 to 1.7 in 1980/81. The increase could be attributed mainly to advances in pediatric medical practice and technology. Additionally, however, the increase could partially be due to greater sophistication and specificity in disease classifications regarding perinatal disorders.

Two categories maintained relatively stable SEP rates over ten years: asthma and bronchitis, and skull fractures. Possibly, there was less room for discretionary hospitalization in these categories than for some of the other categories such as laceration or poisoning.

Table 4

Separation Rates per 1000 Children-Year from 1971 through 1980/81 for Selected Diagnostic Categories

Dx Code[1]	Separation Rates per 1000 Children-Year										
	1971	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	1971-1981
Intest	12.6	12.8	11.9	12.1	11.0	12.2	10.2	10.4	10.5	8.8	11.2
Strab	1.9	1.8	1.7	1.7	1.6	1.4	1.4	1.1	1.0	0.9	1.5
Otitis	3.2	3.0	4.8	4.5	4.9	4.9	5.1	4.5	3.8	3.7	4.2
Ac.Resp	22.8	24.3	21.0	23.6	20.9	20.4	19.8	17.4	17.4	15.2	20.2
Pneum	15.7	18.2	11.6	14.7	14.3	12.3	11.5	9.0	7.4	7.1	12.0
As/Br	7.2	9.3	7.0	7.2	8.0	7.7	7.5	7.0	6.5	6.8	7.4
Tonsil	23.2	18.7	15.7	14.9	16.0	13.6	12.9	11.9	10.4	9.2	14.5
Hernia	2.7	2.6	2.4	2.2	2.2	2.2	2.1	2.0	1.9	1.7	2.2
Cong.Ht	0.9	0.9	0.7	0.6	0.8	0.7	0.7	0.8	0.8	1.0	0.8
Cong.An	4.5	4.5	4.1	3.8	4.0	3.9	3.9	3.8	3.3	3.2	3.9
Peri	0.4	0.5	0.6	0.9	1.1	1.3	1.4	1.5	1.4	1.7	1.1
Skull#	3.2	3.3	3.7	3.7	3.7	3.6	3.6	3.3	3.2	3.0	3.4
Other#	5.1	5.4	5.4	4.9	4.9	5.2	4.6	4.2	4.0	3.8	4.8
Lacer	2.2	2.3	2.0	1.8	1.7	1.7	1.4	1.4	1.3	1.1	1.7
Burn	1.2	1.2	1.2	1.2	1.2	1.1	1.0	1.0	0.8	0.8	1.1
Poison	1.8	2.0	1.9	1.9	1.8	1.9	1.8	1.7	1.3	1.3	1.7
All	156.5	158.9	145.0	150.7	147.1	140.2	134.4	122.8	119.1	106.7	137.5

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[1] Diagnostic category abbreviations are listed in Appendix 4.1

The DAY rates (patient-days per 1000 children-year) for each of the ten years and for the ten years combined are presented in Table 5. Acute respiratory infections and pneumonia had the highest DAY rates over the ten years. Although these two categories had similar DAY rates, their respective SEP rates were substantially different, with pneumonia having the lower SEP rates. The narrowing margin seen in the DAY rates was primarily due to the relatively longer ALOS for pneumonia (see Table 6 for ALOS).

The annual DAY rates for pneumonia varied considerably from a peak in 1972 of 156 days per 1000 children, to the low in 1980/81 of 51 days per 1000 children. Over the ten years, the DAY rate dropped by 62%. The most dramatic decline was again seen for tonsillitis: a 65% decrease over 10 years, from 56 per 1000 in 1971 to 19 per 1000 children-year in 1980/81. This decline however seemed to be primarily due to a reduction in SEPS rather than a significant decrease in the ALOS. Two other categories experienced declines of 60% or more: hernia and laceration. The reasons for these dramatic changes were less easily discernable.

The impact of ALOS on DAY rates could be seen clearly in the burn and perinatal categories which had the two highest ALOS values. Both categories, although small in terms of SEPS per 1000 children-year, had moderately large DAY rates.

Table 5

Patient-day Rates per 1000 Children-Year from 1971 through 1980/81
for Selected Diagnostic Categories

Dx Code[1]	1971	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	1971-1981
Intest	88.8	90.9	81.4	80.1	76.0	79.0	62.3	60.5	63.8	48.1	72.6
Strab	5.5	5.3	4.3	4.1	3.7	3.1	2.8	2.3	2.3	1.7	3.5
Otitis	19.9	17.7	27.2	24.7	23.2	22.7	20.8	17.4	15.7	13.1	20.1
Ac.Resp	129.0	136.1	121.1	125.9	108.2	101.1	92.4	80.6	79.0	71.1	103.7
Pneum	135.9	156.3	102.5	128.5	122.2	105.3	94.0	74.0	56.9	51.2	101.5
As/Br	46.0	58.8	43.4	42.1	46.8	44.3	43.3	38.0	32.8	32.9	42.6
Tonsil	55.9	44.8	35.3	33.4	35.8	29.9	27.6	25.6	22.5	19.5	32.7
Hernia	11.8	11.2	9.1	7.8	7.9	7.1	6.2	6.1	4.9	4.6	7.6
Cong.Ht	11.1	10.9	6.0	5.4	6.7	6.2	6.7	6.0	7.4	8.2	7.4
Cong.An	43.4	47.5	35.2	33.6	30.9	29.9	30.2	29.8	21.4	21.3	32.1
Peri	6.9	9.4	9.8	16.6	22.7	20.1	19.3	22.4	13.9	16.0	15.7
Skull#	10.5	11.9	11.3	11.6	10.9	11.9	11.1	9.8	9.7	7.3	10.6
Other#	32.3	33.9	30.3	30.0	27.1	31.2	27.9	23.8	24.6	22.3	28.2
Lacer	11.7	11.0	10.1	8.0	7.4	7.7	6.6	5.4	5.3	4.3	7.7
Burn	13.1	13.8	14.9	13.5	13.8	13.3	12.1	10.2	9.6	9.3	12.3
Poison	6.0	5.0	6.4	4.6	4.4	4.3	4.2	4.0	3.2	3.1	4.5
All	957.7	1020.3	884.1	911.7	86.20	814.7	751.1	660.3	625.4	543.3	797.5

[1] Diagnostic category abbreviations are listed in appendix 4.1.

Table 6

Average Length of Stay[1] from 1971 through 1980/81 for Selected Diagnostic Categories

Dx[2] Code	1971	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	1971-1981
Intest	7.1	7.1	6.8	6.6	6.9	6.5	6.1	5.8	6.1	5.5	6.5
Strab	2.9	2.9	2.6	2.4	2.2	2.2	2.0	2.0	2.2	1.8	2.4
Otitis	6.2	5.9	5.6	5.5	4.7	4.7	4.0	3.8	4.1	3.6	4.7
Ac.Resp	5.7	5.6	5.7	5.3	5.2	4.9	4.7	4.6	4.5	4.7	5.1
Pneum	8.6	8.6	8.8	8.7	8.5	8.6	8.2	8.2	7.7	7.2	8.4
As/Br	6.4	6.3	6.2	5.8	5.9	5.8	5.8	5.4	5.0	4.9	5.8
Tonsil	2.4	2.4	2.2	2.2	2.2	2.2	2.1	2.2	2.2	2.1	2.2
Hernia	4.3	4.3	3.7	3.6	3.6	3.3	3.0	3.1	2.6	2.7	3.5
Cong.Ht	12.4	12.2	8.8	8.6	8.6	8.9	9.2	7.1	8.9	8.2	9.3
Cong.An	9.5	10.4	8.7	8.8	7.7	7.6	7.8	7.9	6.5	6.7	8.2
Peri	16.9	16.9	15.7	18.5	21.0	15.2	13.5	15.2	9.6	9.7	14.3
Skull#	3.2	3.6	3.1	3.1	3.0	3.3	3.0	3.0	3.0	2.4	3.1
Other#	6.4	6.2	5.6	6.1	5.5	6.0	6.0	5.6	6.1	5.8	5.9
Lacer	5.3	4.7	5.0	4.5	4.4	4.5	4.5	3.9	4.1	3.8	4.5
Burn	10.8	11.7	12.2	11.4	11.6	12.2	12.6	10.3	11.5	11.0	11.5
Poison	3.3	2.4	3.3	2.5	2.5	2.3	2.3	2.3	2.3	2.4	2.6
All	6.1	6.4	6.1	6.0	5.9	5.8	5.6	5.4	5.2	5.1	5.8

[1] Average length of stay in units of days.

[2] Diagnostic category abbreviations are listed in Appendix 4.1.

Albertan pediatric SEP and DAY rates for all diagnoses combined and for selected specific diagnoses were compared to corresponding Canadian rates for 1978 (see Table 7). Comparisons were, however, somewhat limited in that the Canadian rates were based on data from all types of general hospitals. Thus, DAY rates and ALOS's for conditions which often required extended care were likely to be inflated.

Over all diagnoses, Albertan SEP and DAY rates were higher than the Canadian rates. In addition, the Albertan ALOS was slightly shorter than the Canadian ALOS suggesting that the difference in DAY rates was primarily due to differences in volume of use rather than length of use. The selected diagnostic categories offered some insight into these overall differences. The Albertan SEP and DAY rates were substantially higher than Canadian rates for acute respiratory illnesses and pneumonia. The higher rates could reflect regional differences in the incidence of such diseases. Alberta's population, for example, is exposed to a harsh climate relative to the rest of the Canadian population, and may therefore be more prone to acute respiratory illnesses. Similar, but less pronounced differences in the Albertan and Canadian rates were noted for otitis media and asthma and bronchitis. The rates and ALOS's for tonsillitis and hernias were relatively close as might be expected due to the typically surgical nature of hospitalizations in these categories. In the

Table 7

Comparison of Albertan and Canadian[1] Pediatric Utilization of Hospitals in 1978 for Selected Diagnostic Categories[2]

Dx[3] Code	SEPS/1000 Children Alta	Can	DAYS/1000 Children Alta	Can	ALOS in days Alta	Can
Otitis	4.53	3.40	17.45	12.79	3.8	3.8
Ac.Resp	17.38	11.62	80.63	55.99	4.6	4.8
Pneum	8.98	5.01	73.99	38.27	8.2	7.6
As/Br	7.05	5.82	37.98	37.10	5.4	5.3
Tonsil	11.86	12.25	27.60	23.09	2.2	1.9
Hernia	1.96	2.01	6.11	6.41	3.1	3.2
Cong.2	4.60	4.49	35.86	45.99	7.8	10.2
Burn	0.99	0.62	10.20	8.01	10.3	13.0
All	122.80	97.7	660.33	553.5	5.4	5.7

[1] Data Source: Statistics Canada catalogue #82-206, 1978. Data available for "general" hospitals in Canada.

[2] Diagnostic categories were selected for comparison based on availability of compatible data.

[3] Diagnostic category abbreviations are listed in Appendix 4.1.

burns category, the Albertan rates were somewhat higher than the Canadian rates, yet the Albertan ALOS was lower. This difference was unexpected and not readily explained. For congenital anomalies, the Canadian DAY rate and ALOS were higher than the corresponding Alberta figures, although the SEP rates were relatively similar. This was possibly a manifestation of the discrepancy in types of data as noted above. In other words, the Canadian DAY rate and ALOS for congenital anomalies could be inflated by data related to extended care situations.

Comparisons of Albertan rates to other rates which were specific to acute care situations were made possible through the availability of American utilization statistics for "short-stay" hospitals (U.S. Department of Health and Human Services, 1982). In general, the Albertan SEP rates were higher, and in some instances, much higher, than the corresponding American rates (see Table 8). In 1979, Alberta had approximately 17 separations per 1000 children for acute respiratory infections while throughout the U.S. there were only 6.2 separations per 1000 children (under age 15). This seemed to be a substantial difference even in view of the systematic variations in pediatric population compositions, the health care delivery systems, and climatic differences. Rates for the other respiratory categories were also much higher for Alberta. The asthma and bronchitis rate for

Table 8

Comparison of Albertan and American[1] Pediatric Utilization of Hospitals in 1979[2] for Selected Diagnostic Categories[3]

Dx	SEPS/1000 children		DAYS/1000 children		ALOS in days	
Code[4]	Alta[4]	U.S.	Alta	U.S.	Alta.	U.S.
Otitis	3.84	3.60	15.74	7.92	4.1	2.2
Ac.Resp	17.38	4.10	78.97	13.59	4.5	3.3
Pneum	7.38	5.09	56.95	26.52	7.7	5.2
As/Br	6.55	2.99	32.79	11.66	5.0	3.9
Tonsil	10.40	6.40	22.54	11.52	2.2	1.8
Hernia	1.86	2.02	4.86	4.91	2.6	2.4
Cong.2	4.15	3.19	28.83	5.5	6.9	5.5
Peri	1.44	1.41	13.86	10.92	9.6	7.8
Burn	0.83	0.58	9.59	6.21	11.5	10.7
Poison	1.35	0.73	3.16	2.06	2.3	2.8
All	119.13	72.7	625.44	312.61	5.2	4.3

[1] Data Source: U.S. Department of Health and Human Services, 1982.

[2] Data for U.S. relates to 1979 calendar year but data for Alberta relates to fiscal year 1979/80.

[3] Diagnostic categories were selected for comparison based on availability of compatible data.

[4] Diagnostic category abbreviations are listed in Appendix 4.1.

Alberta was 6.5 per 1000 and 3.0 per 1000 for the U.S. The pneumonia rate in Alberta was 7.4 per 1000 while the U.S. rate was 5.1. Alberta also had more tonsil separations (10.4 per 1000) than the U.S. (6.4 per 1000). Two Alberta rates, of the selected diagnostic categories, were relatively close to the U.S. rates: otitis media and hernia. Overall, Albertan children, in 1979, experienced 123.2 SEPS per 1000 while American children experienced only 72.7 SEPS per 1000 children-year.

The Albertan patient-day rates for the selected diagnostic categories were typically much higher than the corresponding American rates. The most dramatic differences were seen for the three respiratory illness categories and the congenital anomalies category. In the acute respiratory infections category, for example, the rate for Albertan children was nearly 79 DAYS/1000 children while the rate for American children was 13.6 DAYS/1000 children. The difference could be attributed in part to a larger ALOS for Albertan children (4.5 as compared to 3.3 days), but primarily, it appeared to be the larger Albertan SEP rate that contributed most to the difference in DAY rates. This pattern was repeated, to varying degrees, in all the diagnostic categories. For all diagnoses combined the DAY rates were again substantially different with 625.4 DAYS/1000 Albertan children compared to only 312.6 DAYS/1000 American children. In relative terms, the respective SEP rates contributed more to the difference in DAY rates than did the respective ALOS's. If, for example the Albertan ALOS was reduced to the American level (4.3 days), the revised Albertan DAY rate (512.3 patient days/1000 children) would still be much higher than the American DAY rate.

The reason, or reasons, for the large difference in American and Albertan pediatric SEP rates can not be inferred from these comparisons. It did, however, seem clear that such large differences were not likely due to statistical artifact or chance variation. It could be, for example, that there are more beds, or at least more readily accessible beds, available to Albertan children as compared to children across the United States. Such reasoning is, however merely speculation. Further research would be required to gain insight into the nature of the differences in the Albertan and American SEP rates.

4.2.3 Summary

The utilization of acute care pediatric services in Alberta, for all diseases combined, peaked in 1972 then steadily declined to the lowest level of the study period in 1980/81. This declining trend was consistent with Canadian patterns of pediatric utilization, and with Albertan and Canadian patterns of utilization for all age groups.

Children under age one year used the largest proportion of total hospital SEPS and DAYS per child of all the pediatric age groups. Over time, the Alberta data paralleled the national trend toward increasing DAYS for children under one year and decreasing DAYS for children of one to fourteen years.

The dominant age group, in terms of contribution to SEPS or DAYS varied characteristically among the diagnostic categories being examined. The 1-4 year age group, for example, contributed the greatest percentage of SEPS as compared to the other age groups for diseases such as otitis media, and poisonings. Similarly, the 5-9 year age group contributed the greatest percentage of SEPS in the tonsillitis category.

Trends in utilization also varied characteristically among the selected diagnostic categories. Tonsillitis SEPS, for example, dramatically declined by 60% over the ten years. This decline was consistent with a national trend of declining tonsillectomies but was much more rapid than the general decline experienced by other categories. Perinatal disorder SEPS, on the other hand, did not follow the general pattern of decline and, instead, increased considerably between 1971 and 1980/81.

Comparisons of Albertan and Canadian pediatric utilization rates for 1978 revealed that the Albertan DAY rate was roughly 15% higher than the Canadian rate for all diagnoses combined. Much of the difference appeared to be due to a higher Albertan SEP rate, as opposed to a longer Albertan ALOS. Diagnostic categories with Albertan rates substantially higher than Canadian rates included respiratory illness categories which could be influenced by the relatively harsh Albertan climate.

Comparisons of Albertan and American pediatric utilization rates for 1979 revealed that the Albertan DAY rate was nearly 100% higher than the American rate for all diagnoses combined. This difference was a function of a larger Albertan SEP rate and longer Albertan ALOS. These large differences were speculated to be a function of greater bed availability/accessibility in Alberta. Diagnostic categories with Albertan rates substantially higher than American rates again consisted primarily of the respiratory illness categories.

4.3 District Pediatric Utilization Rates

District utilization rates, in terms of SEPS and DAYS, were calculated for each diagnostic category for the years 1971, 1976, and 1980/81 and for all years combined. When district rates were summarized in the form of rate distributions, it was evident that all distributions were positively skewed, particularly the SEP and DAY rates for intestinal infections, acute respiratory infections, and pneumonia. Most of the distributions maintained their general shape and skew over time, albeit with some fluctuations. The only trends established over time were a decrease in the distributional skew for congenital anomalies, and increase in skew for otitis media, acute respiratory infections, and pneumonia. The decreasing skew for congenital anomalies could have been due to increased detail and precision in congenital disorder chapters of the disease classification systems over time. The more widely skewed distributions, such as pneumonia, suggest either pockets of high incidence or tendencies to liberally clump diseases into broadly defined categories.

Because most of the changes in the disease specific rate distributions over time primarily represented fluctuations and minor variations, the details of this analysis are not presented. Instead, Tables 9 and 10 present summary distributions for district SEP and DAY rates, respectively, for all ten years combined.

The distribution ranges demonstrated the wide variations in district rates. The ranges compared to the corresponding provincial rates also provided an approximation of the distributional skew, which was most pronounced for infectious type illnesses. The typical SEP and DAY distributions had the Edmonton and Calgary rates below the provincial rate and toward the lower end of the rate range. In the few distributions where the Edmonton or Calgary rates were above the provincial rate, it was not by a large margin. In the strabismus SEP rate

Table 9

Distribution Summary of District Separation Rates[1]
for 1971 - 1980/81

Dx Code[2]	Edmonton Rate	Calgary Rate	Provincial Rate	Range	% SP Below[3] Prov. Rate
Intest	7.45	5.11	11.21	5.0 - 96.0	71
Strab	1.66	1.76	1.46	0.2 - 2.7	36
Otitis	2.33	2.86	4.23	1.1 - 36.0	71
Ac.Resp	11.05	8.00	20.18	8.0 -131.4	68
Pneum	8.51	4.87	12.05	3.3 -126.8	74
As/Br	4.85	4.47	7.04	1.6 - 35.4	65
Tonsil	12.86	13.56	14.52	5.2 - 42.3	72
Hernia	2.31	2.00	2.17	0.2 - 5.2	47
Cong.Ht	1.00	0.61	0.80	0.0 - 3.4	54
Cong.An	4.01	3.96	3.89	1.2 - 7.5	27
Peri	0.69	0.63	1.10	0.2 - 3.3	64
Skull#	2.96	2.68	3.44	1.4 - 10.1	66

Table 9 continued

Dx Code[2]	Edmonton Rate	Calgary Rate	Provincial Rate	Range	% SP Below[3] Prov. Rate
Other#	3.47	3.81	4.76	2.1 - 13.6	68
Lacer	1.09	0.88	1.69	0.9 - 11.5	66
Burn	0.07	0.50	1.06	0.3 - 7.8	69
Poison	1.21	0.92	1.74	0.9 - 6.7	65
All	100.30	82.93	137.52	82.9 -597.2	64

[1] Rates represent the number of separations per 1000 children-year.

[2] Diagnostic Category abbreviations are listed in Appendix 4.1.

[3] The percentage of pediatric service population residing in districts with SEP rates below the provincial SEP rates.

Table 10

Distribution Summary of District Patient-day Rates[1]
for 1971 - 1980/81

Dx Code[2]	Edmonton Rate	Calgary Rate	Provincial Rate	Range	% SP Below[3] Prov. Rate
Intest	50.30	32.39	72.60	20.9 - 796.6	81
Strab	4.14	3.38	3.47	0.5 - 7.2	61
Otitis	7.86	7.81	20.07	1.9 - 329.6	79
Ac.Resp	52.60	37.24	103.66	31.6 - 975.7	74
Pneum	62.67	36.96	101.48	19.1 -1449.5	80
As/Br	24.91	24.86	42.62	6.4 - 304.7	76
Tonsil	27.60	28.46	32.74	11.3 - 99.3	74
Hernia	7.51	6.54	7.60	0.2 - 45.7	74
Cong.Ht	8.57	5.38	7.45	0.0 - 35.8	54
Cong.An	28.22	34.91	32.09	6.7 - 94.0	52
Peri	10.09	11.35	15.74	1.2 - 61.7	66
Skull#	9.61	9.65	10.56	3.2 - 25.0	76

Table 10 continued

Dx Code[2]	Edmonton Rate	Calgary Rate	Provincial Rate	Range	% SP Below[3] Prov. Rate
Other#	21.71	26.12	28.23	3.1 - 65.6	69
Lacer	4.67	3.87	7.66	2.0 - 59.7	70
Burn	9.04	6.52	12.28	0.6 - 90.4	77
Poison	4.04	3.01	4.50	1.5 - 16.8	73
All	576.42	481.98	797.49	406.4 -4762.9	75

[1] Rates represent the number of patient days per 1000 children-year.

[2] Diagnostic Category abbreviations are listed in Appendix 4.1

[3] The percentage of pediatric service population residing in districts with DAY rates below the provincial DAY rate.

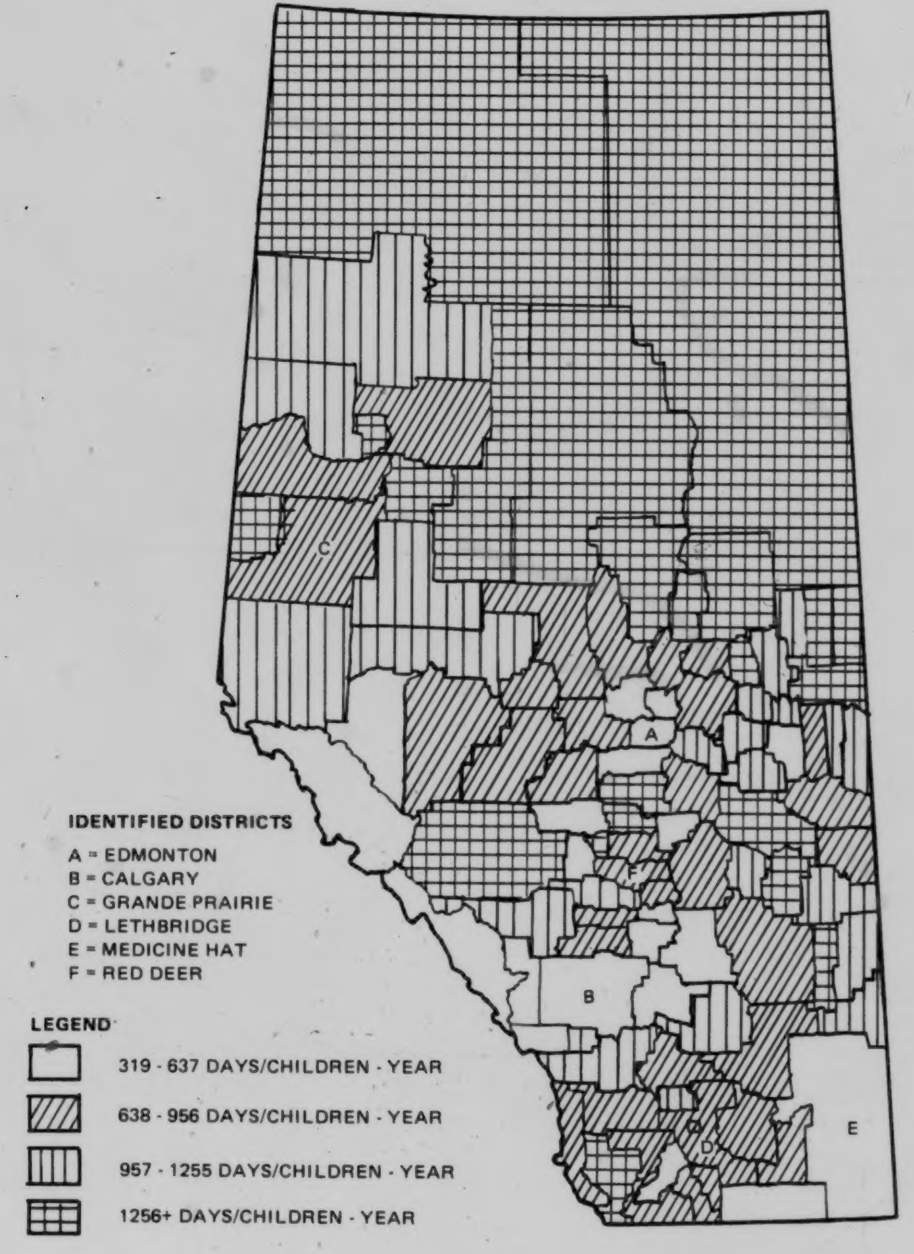
distribution, for example, the Edmonton and Calgary rates were 1.66 and 1.76 SEPS per 1000 children-year as compared to the provincial rate of 1.46 SEPS per 1000 children-year. It could be that Edmonton and Calgary area children had greater access, than children in other areas, to physicians and facilities that could diagnose and treat strabismus thereby elevating the SEP rate relative to others.

The major implication of the relatively "low" Edmonton and Calgary rates was that at least 52% of the service population would, therefore, live in districts with utilization rates lower than the provincial rate. The provincial rate did not necessarily represent the level of utilization experienced by half the service population as might be intuitively expected. In the pneumonia DAY rate distribution, for example, 80% of the service population experienced rates, over ten years, which were lower than the provincial rate. The Edmonton and Calgary districts contributed their 52% of the service population while other districts contributed the remaining 28%. Because Edmonton and Calgary rates were typically below the provincial rate, the proportion of the service population which collectively experienced rates below the provincial rate was typically well above 52%. Thus, the "norm" or most commonly experienced utilization rates were often more effectively represented by the Edmonton and Calgary rates than by the provincial rates.

District utilization rates were also examined according to their geographic distribution. Figure 4 illustrates the levels of district DAY rates for all ten years combined and for all diagnostic categories combined. The rate distribution was divided into four exclusive and exhaustive categories which represent relatively low rates (60% to 20% below the provincial rate), moderate rates (within plus or minus 20% of the provincial rate), high rates (20% to 60% above the provincial rate), and very high rates (more than 60% above the provincial rate). As can be seen from the figure, the very high DAY rates were found primarily in the northern districts but were also scattered throughout the province. The low rates, on the other hand, were found near Edmonton, Calgary, Medicine Hat, and the mountains. High and very high DAY rates in the north could be due to a lack of alternative health care services. In such a situation most of the health care burden would be placed on hospitals. Additionally, limited alternatives could prevent children from seeking formalized health care before their condition was relatively advanced. Longer average length of stay, therefore, could be a contributing factor, but not the cause of high DAY rates because northern district SEP rates were also relatively high. The east-central border districts and the Wetaskiwin and Ponoka districts also had relatively high rates, but these were more difficult to explain.

FIGURE 4

LEVEL OF DISTRICT DAY RATES FOR ALL DIAGNOSES COMBINED AND FOR ALL YEARS COMBINED


A
B
C
D
E
F
IDENTIFIED DISTRICTS
A = EDMONTON
B = CALGARY
C = GRANDE PRAIRIE
D = LETHBRIDGE
E = MEDICINE HAT
F = RED DEER
LEGEND
319 - 637 DAYS/CHILDREN - YEAR
638 - 956 DAYS/CHILDREN - YEAR
957 - 1255 DAYS/CHILDREN - YEAR
1256+ DAYS/CHILDREN - YEAR

In summary, there was wide variation in the SEP and DAY rates among the districts. For each diagnostic specific rate distribution, a few districts, although not the same districts, had extremely high rates. The rate distributions, therefore, were all positively skewed to some degree. Districts with service populations that were too small to average out wide fluctuations in DAYS or SEPS were particularly apt to have extreme rates. However, no district had rates which were extremely high consistently over time. The variations were, therefore, attributed primarily to chance, error, artifact, or other nonsystematic cause. The geographic distribution of rate levels indicated that northern districts were also more likely to have relatively high utilization rates. Restricted access to alternative forms of health care was suggested as a contributing factor. Conversely, districts with well developed health care delivery systems such as Edmonton and Calgary were seen to have relatively low rates of hospital utilization.

4.4 Regional Variations in Pediatric Utilization Rates

For regional analyses, diagnostic categories were aggregated into ten categories. The skull fracture and general fracture categories were combined with lacerations into one category representing trauma. It was thought that the skull fracture category did not demonstrate utilization patterns different enough from general fractures to warrant a special category. In addition, lacerations seemed to be logically compatible with a generic trauma category. The congenital heart anomalies category was combined with all other congenital anomalies. It was thought that much of the apparent district variation, and perhaps regional variation, was due to the relatively low incidence of this diagnosis. Combining the categories would provide more stable and reliable utilization rates. Strabismus was dropped entirely and added to the category of "other diseases" for much the same reason. The hernia category was dropped mainly because it contributed so little of the variation in SEPS or DAYS among districts. Poisoning was also dropped, primarily because it accounted for such a small proportion of DAYS that it was thought to be relatively unimportant in the overall pattern of pediatric utilization.

After these changes, ten diagnostic categories remained: 01) intestinal infections, 02) otitis media, 03) acute respiratory illnesses (infections and influenza), 04) pneumonia, 05) asthma and bronchitis, 06) tonsillitis, 07) congenital anomalies, 08) perinatal disorders, 09) fractures and lacerations, and 10) burns. The presentation of the investigation's results are accordingly subdivided into the diagnostic categories. The analyses concentrate on DAY rate measures of utilization. SEP rates and ALOS are indirectly represented through their relationship to the DAY rates.

4.4.1 Rates for All Diagnoses Combined

To provide a reference point for generalized regional utilization trends, regional utilization measures were examined for total DAYS and total SEPS. The results of the examination are presented in this section.

Table 11 presents regional DAY rates for all DAYS combined, for the four regional aggregates described in section 3.3.3. Rates are presented for the years 1971 through 1980/81 and for the rate experienced over ten years. The provincial rates are included for comparison.

The DAY rates for the MAP A aggregate were well below the provincial rates for all ten years. The metro-center rates were relatively similar although the Metro-Edmonton rates were also somewhat higher than the Metro-Calgary rates. The relative difference between the metro-center rates tended to increase with time. The Metro-Edmonton rate dropped by 47% during the same period. Differences in the DAY rates were due partially to higher SEP rates and higher ALOS measures in Metro-Edmonton (see Tables 12 and 13 respectively). Reasons for the differences in Metro-center rates, albeit minor, were not immediately obvious. Possible explanations included epidemiological factors, patterns of pediatric practice, availability of physicians, or availability of beds. With

Table 11

Patient-day Rates[1] for Aggregated Regional Areas in Alberta

Area[2]	1971	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	71-80/81
Alta	957.7	1020.3	884.1	911.7	862.0	814.7	751.1	660.3	625.4	543.3	797.5
Met.Ed	675.8	712.6	623.4	617.5	609.9	573.7	535.0	498.6	469.7	432.7	576.4
Met.Ca	602.1	643.4	559.3	584.2	509.6	485.1	424.8	371.8	363.8	317.7	482.0
Nor	1111.7	1192.9	1035.9	1057.3	1019.8	967.2	904.0	793.2	744.2	642.4	940.8
Sou	728.9	764.8	660.8	698.2	631.3	591.9	527.7	466.1	451.7	398.1	587.3
Metro	640.5	679.0	592.0	601.0	559.7	528.8	478.7	433.2	414.6	372.4	528.9
Reg	925.3	890.2	769.8	804.3	759.3	713.2	671.0	582.1	559.9	475.2	703.6
Rural	1417.8	1530.2	1312.2	1354.8	1283.4	1204.7	1116.1	964.9	904.0	770.6	1172.1
Edm	1091.9	1182.5	1028.1	1044.1	1010.1	956.7	890.8	789.8	745.9	645.0	933.4
Calg	669.9	715.4	615.2	649.8	578.6	558.1	485.3	420.5	407.4	357.7	541.5
Gr.Pr.	1476.8	1580.0	1247.6	1472.1	1344.9	1344.8	1205.3	1099.7	893.6	730.3	1217.2
Leth	952.5	897.1	923.5	928.1	871.6	739.7	694.8	620.3	600.8	534.3	780.6
Mad.Ht	890.8	762.1	584.9	722.1	702.3	607.3	610.2	564.6	579.4	504.3	644.3
Rd.Dr.	1127.0	1096.4	973.0	940.6	901.9	841.7	846.4	668.3	653.9	586.6	853.8

[1] Rates represent the number of patient-days per 1000 children-year for all diagnoses combined.

[2] Area titles and abbreviations are listed in Appendix 4.2.

Table 12

Separation Rates[1] for Aggregated Regional Areas in Alberta

Area[2]	1971	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	71-80/81
Alta	155.5	158.9	145.0	153.7	147.1	140.2	134.4	122.8	119.1	105.7	137.5
Met.Ed	115.7	117.9	105.5	105.5	104.4	102.2	94.7	88.7	87.0	79.6	100.3
Met.Ca	97.7	100.9	92.3	96.0	89.0	82.4	72.5	71.6	66.9	60.3	82.9
Nor	177.8	180.2	165.1	169.6	167.6	160.1	153.0	139.2	135.6	119.8	156.1
Sou	125.0	127.3	115.6	123.0	117.2	111.1	107.3	98.8	95.0	87.6	110.3
Metro	107.1	109.7	99.0	100.8	96.7	92.1	85.9	79.9	76.6	69.5	91.6
Reg	162.9	160.0	145.8	149.0	149.0	142.9	142.0	125.1	121.1	109.2	139.3
Rural	225.7	227.8	208.2	218.3	213.0	201.1	194.2	176.2	171.7	152.1	197.4
Edm	171.8	175.7	161.7	165.2	163.5	156.4	148.3	136.3	133.8	118.3	152.5
Calg	111.7	115.1	104.2	111.3	104.9	98.9	93.5	85.5	80.8	73.4	97.4
Gr.Pr.	248.5	243.0	204.4	227.1	207.1	204.2	187.1	187.2	166.9	141.6	199.1
Leth	175.4	169.2	164.4	170.2	164.1	154.2	154.0	137.4	137.8	133.6	155.6
Med.Ht	157.4	159.7	128.7	141.5	142.5	135.5	143.4	143.3	149.9	135.3	143.4
Rd.Dr.	206.6	200.0	181.2	185.4	189.7	179.3	188.2	151.4	142.8	131.3	174.1

[1] Rates represent the number of separations per 1000 children-year for all diagnoses combined.

[2] Area titles and abbreviations are listed in Appendix 4.2.

Table 13

Average Length of Stay[1] for Aggregated Regional Areas in Alberta

Area[1]	1971	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	71-80/81
Alta	6.1	6.4	6.1	6.0	5.9	5.8	5.6	5.4	5.2	5.1	5.8
Met.Ed	5.8	6.0	5.9	5.8	5.8	5.6	5.6	5.6	5.4	5.4	5.7
Met.Ca	6.2	6.4	6.1	6.1	5.7	5.9	5.5	5.2	5.4	5.3	5.8
Nor	6.2	6.6	6.3	6.2	6.1	6.0	5.9	5.6	5.5	5.4	6.0
Sou	5.8	6.0	5.7	5.7	5.4	5.3	4.9	4.7	4.7	4.5	5.4
Metro	6.0	6.2	6.0	6.0	5.8	5.7	5.6	5.4	5.4	5.4	5.8
Reg	5.7	5.6	5.3	5.4	5.1	5.0	4.7	4.6	4.6	4.3	5.0
Rural	6.3	6.7	6.3	6.2	6.0	6.0	5.7	5.5	5.3	5.1	5.9
Edm	6.4	6.7	6.4	6.3	6.2	6.1	6.0	5.8	5.6	5.4	6.1
Calg	6.0	6.2	5.9	5.8	5.5	5.6	5.2	4.9	5.0	4.9	5.6
Gr.P.	5.9	6.5	6.1	6.5	6.5	6.6	6.4	5.9	5.3	5.2	6.1
Leth	5.4	5.3	5.6	5.4	5.3	4.8	4.5	4.5	4.4	4.0	5.0
Med.Ht	5.7	4.8	4.5	5.1	4.9	4.5	4.2	3.9	3.9	3.7	4.5
Rd.Dr.	5.4	5.5	5.4	5.1	4.7	4.7	4.5	4.4	4.6	4.5	4.9

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[1] Average length of stay is calculated in units of days for all diagnoses combined.

[2] Area titles and abbreviations are listed in Appendix 4.2.

regard to the latter point, throughout the ten years, Calgary has had fewer pediatric beds per 1000 children than Edmonton. In 1979/80, for example, Calgary had 2.4 pediatric beds per 1000 while Edmonton had 3.8 pediatric beds per 1000 children.

Contrary to expectation, there was a substantial difference between the DAY rates for the MAP 8 aggregate of North and South regions. The North DAY rate was typically much higher than the South DAY rate. This pattern was relatively stable over the ten years. Again, the differences in North, South rates were composed of differences in SEP rates and ALOS's. Reasons for the unexpected variations were not clear. To speculate, however, higher DAY rates in the North could be related to greater travel distances to care centers. It could be that travel distances or conditions tend to delay medical attention until more aggressive medical intervention is required. Perhaps more days were used to facilitate observation of patients who lived in relatively remote areas. If this supposition were true, one would expect the ALOS to be longer in the northern region. This was in fact the case, as seen on Table 13. Another influential determinant of utilization in Northern Alberta could be the harsher climatic conditions. It could be that the incidence of respiratory illnesses, for example, would be inherently higher in such an environment. Because respiratory conditions contribute over 31 percent of the total patient-days, anything influencing respiratory conditions could skew all patient-days.

MAP C DAY rates revealed the expected pattern. Rates for Metropolitan areas, with tertiary care centers, were lower than the provincial DAY rate for each year studied. Conversely, rates for Rural areas, with only primary care centers, were consistently higher than the provincial rate. The Regional areas, with secondary care centers, had rates which fell between the metropolitan and rural rates. The Regional rates were closest to the provincial rate, although were generally somewhat lower. The marked variation of rates among the areas was noted for all ten years. It should be noted however that the availability of care within the regions is only one of many possible reasons for the rate variations. For example, if a large number of pediatric admissions and patient days are for social reasons, large variations would be expected for rates of this Metropolitan/Regional/Rural aggregation.

SEP rates for MAP C presented a similar pattern. The pattern for ALOS was however unexpectedly different. The ALOS for Regional areas was consistently lower than both the Metropolitan and Rural areas ALOS's and lower than the provincial ALOS. Metropolitan and

Rural ALOS's were very similar to provincial levels over the ten years, with the Rural ALOS tending to be slightly higher. This pattern suggested that ALOS contributed relatively little to the wide variation between DAY rates for Metropolitan and Rural areas. Thus, much of the variation must have been due to differences in SEPS. It therefore appeared that children living in Metropolitan areas were less likely than Rural or Regional children to be admitted to hospital. Such variations in SEP rates could be due to any one, or combination of utilization determinants which were inherently different with respect to the aggregate areas. Children living in Metropolitan areas were perhaps more likely to be observed or treated in health care settings other than hospitals. Similarly, they were perhaps admitted for relatively more serious conditions so that they needed longer hospital stays than their counterparts in Regional areas. Children in Rural areas perhaps tended to be admitted for relatively minor illnesses due to a lack of alternative health services. In addition, they perhaps stayed longer than their Regional counterparts due to observation needs or due to longer travel distances to health services.

The MAP D aggregate tended to reinforce the North/South variation noted above. The Edmonton and Grande Prairie regions, both including large expanses of northern Alberta, had DAY rates much higher than the provincial rates. The Grande Prairie region consistently had the highest rates. Red Deer and Edmonton regions had very similar rates, both higher than provincial rates, but Edmonton region's rates were generally higher than Red Deer rates. The southern regions of Calgary and Medicine Hat had DAY rates consistently lower than the provincial rate, with Calgary rates being the lowest. The Lethbridge regional rates fluctuated above and below the provincial rate over the ten years.

The SEP rates revealed a similar pattern, albeit with less dramatic variation. Grande Prairie generally had the highest rates with the Red Deer regional rates next highest. The Edmonton and Lethbridge rates were also consistently higher than the provincial rate but they changed position relative to each other over time. The SEP rates for Medicine Hat declined less sharply than those for other regions over the ten years, so that although the Medicine Hat rate was lower than the provincial rate in 1971, it was well above the provincial rate, and second only to the Grande Prairie rate by 1980/81. Calgary regional rates were consistently the lowest rates, well below the provincial level for all ten years. The reason(s) for these variations were not clear.

The ALOS levels for the large northern regions of Edmonton and Grande Prairie were typically higher than the provincial levels. The Calgary regional ALOS was also consistently above the provincial ALOS over 10 years, although not by a large margin. The relatively high ALOS for the Calgary region may reflect the relatively large land mass covered by the aggregated districts for that region. The Red Deer, Medicine Hat and Lethbridge regions all had ALOS levels consistently lower than provincial levels over the ten years. The Medicine Hat ALOS levels were generally the lowest.

4.4.2 Rates by Diagnostic Specific Categories

Due to the repetitious nature of these analyses, only highlighted reviews of each disease specific regional analysis will be presented in this section. For reference, to complete results of the regional DAY rate analyses, ten disease specific tables are presented in Appendix D.

Intestinal Infections

The patterns of regional DAY rates for intestinal infections paralleled the patterns of DAY rates for all diseases combined (as in Table 9). For the Map A and B aggregates, the Metro-Edmonton and North region had higher rates than their Metro-Calgary and South region counterparts. Both metro-center rates and the South region rate were below their corresponding provincial rates over the ten years. The Map C aggregate was also similar in that the rates suggested that children living in Metropolitan areas used fewer hospital days (per 1000 children-year) for intestinal infections than their Regional and Rural area peers. Again, variations were assumed to be related to differing levels of care available within the child's region of residence. With regard to the Map D aggregate, the Grande Prairie and Edmonton regions consistently had the highest rates while the Calgary and Medicine Hat regions consistently had the lowest rates. It seemed that the rates followed a north-south, west-east gradient. Epidemiological factors, difficult access to care in northern areas, or limited access to physicians in certain areas could conveivably influence these patterns of utilization.

Otitis Media

In the Map A aggregate, both metro-center rates were similar to each other but had no stable relationship over time, except that they were both below the provincial rates. It appeared that the determinant factors related to the Map B North/South aggregate had also influenced the otitis media DAY rates because the North rates were typically higher, and the South rates typically lower than the provincial rates. The Map C aggregate demonstrated the familiar pattern of relatively low Metropolitan DAY rates and relatively high Rural DAY rates. However, the variation among regions decreased over time, primarily due to a relatively large decrease in Rural rates. In addition, much of the rate variation appeared to exist within regions rather than between regions. The Regional rates, for example, followed no discernable pattern over time. It was therefore doubtful that rate variations were due to determinant factors which defined the aggregate regions (i.e. availability of levels of care). A similar situation appeared in the Map D aggregate rates. Again, due to unstable patterns over time and wide fluctuations of rates within regions, it seemed unlikely that rate variations among regions could be a function of region specific determinant factors.

Acute Respiratory Infections and Influenza

The regional DAY rate patterns for Maps A, B, and C, were very similar to the patterns seen for all diseases combined and for intestinal infections. Explanations for these patterns could be very similar to those discussed for all diseases combined. The Map D aggregate, however, revealed patterns slightly different from those described for all diseases combined. Although Grande Prairie region had the highest rates (except in 1980/81) and the Calgary region consistently had the lowest rates, as for all diseases combined, the other regional rate relationships were different. The Red Deer rates, for example were usually higher than Edmonton regional rates. Lethbridge regional rates dropped greatly over the ten years from a level well above the provincial rate in 1971 to a level well below the provincial rate in 1980/81. Medicine Hat region rates, on the other hand, increased over time in a reverse of the Lethbridge pattern. The reasons for such rate variations among regions over time were not immediately obvious and were assumed to be multifactorial.

Pneumonia

Regional DAY rates for pneumonia as seen in the Map A, B, and C aggregates were again very similar to the patterns seen for all diseases combined. The pattern of rates for the Map D aggregate was slightly different. Grande Prairie had the highest regional rates by a large margin. The Edmonton region had relatively high rates but not comparable to Grande Prairie. The Medicine Hat and Calgary regions had the lowest rates but Medicine Hat had rates which were generally lower than the Calgary region rates. Despite the differences in pattern details from other disease categories (all diseases combined, intestinal infections and acute respiratory illnesses), the highest rates for pneumonia were still found in the two northern regions while the lowest were in southern regions.

Asthma and Bronchitis

The patterns of regional DAY rates were similar to those of previous respiratory categories although there was much less variation among the regions. The two metrocenter rates in Map A, for example, were very close in relation to each other throughout the ten years. Similarly, there was not a wide margin between the North and South region rates of the Map B aggregate. This pattern suggested that asthma and bronchitis DAY rates were less influenced by the utilization determinants of the North-South aggregate than were rates of the other respiratory categories. Climatic conditions, for example, may have a greater influence on the number of, or severity of, acute respiratory illnesses and pneumonia cases (generally acute conditions) than on the number of, or severity of, asthma and bronchitis cases (generally chronic, recurring conditions.

The Map C regional rates demonstrated the expected pattern, with Metropolitan children having the lowest and the Rural children having the highest DAY rates over the ten year period. The Map D aggregate continued to demonstrate similar patterns to the other two respiratory categories (and intestinal infections) but with less pronounced variation among regions.

Tonsillitis

The metro-center DAY rates for Map A were, as expected, very similar to each other and both lower than the provincial rates. Over time, however, the metro-center rates moved closer and closer to the provincial rate. There may have been, over time, a declining impact of utilization determinants related to metro-center location of residence. Perhaps the professional examination of tonsillectomy procedures over the years has served not only to decrease tonsil related DAYS but to decrease variations in regional practices so that tonsil rates have moved closer to an "accepted" norm. Regarding Map B, North and South region rates and provincial rates were virtually identical over the ten years. It appeared that determinant factors related to North-South areas of residence were of little importance in tonsillitis cases.

The Map C regional rates also followed the expected pattern of low Metropolitan and high Rural rates. Remarkably however, the variation among regions nearly disappeared over time. As a result, the 1980/81 rates appeared relatively insensitive to the determinant factors inherent in the Map C aggregation. Again, increasingly uniform attitudes and practices regarding tonsillectomies could explain much of the reduction in rate variations over time. Regional rate patterns for Map D also demonstrated decreasing rate variability over time. The most dramatic decrease in variation occurred between 1971 and 1973. Over the ten years, the Grande Prairie regional rates dropped by 88% from a 1971 level well above the provincial rate levels closer to, and generally lower than, the provincial rates. The other regions also had rates relatively close to the provincial rate in 1980/81.

Congenital Anomalies

The DAY rates for congenital anomalies were expected to be relatively stable across regions compared to other diagnostic categories. In general, over the ten years, this appeared to be true. Over the ten year period both the metro-center rates for Map A and the North and South rates for Map B were very close to provincial rates. The DAY rates for Map C were tightly clustered around the provincial rates, particularly in the last two study years. The regional rates fluctuated in their relative positions over the years but differences were not large enough to be considered as regional rate variations. The same pattern held true for the Map D aggregate. The minor variations, or fluctuations that did exist among Map D regions decreased remarkably over time.

The limited variability was thought to be a function of several possible reasons. The decisions to hospitalize children with congenital anomalies could be less discretionary than decisions to hospitalize children for acute respiratory illnesses for example. In addition, epidemiological determinants for congenital illnesses were probably less susceptible to regional variations. Finally, the apparent lack of regional rate variation could be the result of a narrowly defined, objectively verifiable diagnostic category. The category for acute respiratory illnesses, for example, could be applied to a highly diverse group of illnesses with equally diverse epidemiological determinants and requirements for treatment. In a more homogeneous category, such as congenital anomalies, it could be that rates would be less variable due to a "standardization" effect within the disease category itself.

Perinatal Disorders

Patterns of perinatal DAY rates were expected to be similar to those for congenital anomalies. Perinatal rates were, however, fundamentally different in that they increased, rather than decreased, over time. Despite the difference, Maps A and B demonstrated very little variation in the regional metro-center or North-South perinatal DAY rates.

The Map C aggregate regional rates had a somewhat atypical pattern. In 1971, the Metropolitan rate was higher, and the Rural rate was lower, than the provincial rate. By 1980/81 the Metropolitan and Rural rates had converged to the provincial rate. The Regional rates were situated between the Metropolitan and Rural rates until 1976, but from 1977 onward the Regional rates exceeded both. This pattern of variation was not easily explained.

The Map D rates revealed a pattern of wide variation within regions over time. Grande Prairie rates, for example, were generally well above provincial rates but varied widely from one year to the next. Medicine Hat also had widely variable rates. Due to the variable rate patterns within regions, the relative position of regional rates (which was highest or lowest) also varied considerably over time. Much of this variation could be a function of the relative rarity of, and typically long hospital stays for, perinatal disorders. The rates for small population areas would be very sensitive to relatively small changes in the number of perinatal SEPS and DAYS. In addition, perinatal disorders may characteristically require repetitive admissions which would inflate both SEPS and DAYS, particularly in small population areas. Such sensitivity would be magnified in the smaller population areas such as Grande Prairie or Medicine Hat. In support, the Edmonton and Calgary regions, with relatively large population bases, appeared to be less sensitive to wide rate variations.

Fractures and Lacerations

The regional DAY patterns for fractures and lacerations were similar to those for congenital anomalies, albeit somewhat more varied. The metro-center rates were consistently slightly below provincial rates with the Metro-Calgary rates tending to be higher than Metro-Edmonton rates. Map B rates were very close together over the ten years. The Map C aggregate revealed wider variations in regional rates, although the degree of variation decreased with time. However, as the Metropolitan and Regional rates moved closer together, the Rural rates remained relatively high. This pattern suggested that the determinant factors relevant to the Rural aggregation (i.e. lower access to care and active outdoor lifestyles) may influence the DAY rates for fractures and lacerations.

The Map D aggregate rate pattern was somewhat atypical in that Red Deer, rather than Grande Prairie or Edmonton, usually had the highest regional rates. Over the ten years, the other regional rates were relatively close to each other and to the provincial rate. There was no immediately obvious explanation for the relatively high Red Deer rates.

Burns

The DAY rates for burns followed a relatively typical pattern, very similar to that for all diseases combined, although with much less variation among regions and over time. As with the "typical" patterns, metro-center rates tended to be lower than provincial rates, but the Metro-Edmonton rates were higher than Metro-Calgary rates. Similarly, North region rates were consistently higher, and South region rates consistently lower, than the provincial rates. These relationships remained relatively stable over time. The Map C aggregate demonstrated the common Rural high--Metropolitan low, rate patterns. The Map D rate pattern was not so clearly typical due to wide rate variations within some regions over time. As with perinatal disorders, the relative rarity burns (requiring hospitalization) and the typically extended durations of stay may have contributed to wide rate variations, particularly in the regions with relatively small populations.

4.4.3. Summary

The typical pattern of regional variation for the Map A aggregation was when both metro-center rates were below the provincial rates with Metro-Edmonton rates being higher, by varying degrees, than the Metro-Calgary rates. This pattern was seen for all diseases combined, intestinal infections, acute respiratory illnesses, pneumonia, and burns. It was suggested that DAY rates for the metro-center areas were likely lower than provincial rates due to the wide variety of other health care delivery options for children in Edmonton and Calgary. Similarly, perhaps greater accessibility to health monitoring services reduces the need for, or length of, hospitalizations in metropolitan areas. The reason for higher DAY rates for residents of Metro-Edmonton, as compared to Metro-Calgary residents, was suggested to be a function of the large number of pediatric beds per 1000 children in Edmonton as compared with Calgary. It was assumed that most epidemiological factors would be similar, but perhaps the milder climatic conditions in Calgary were sufficiently different to additionally influence patterns of hospital use, particularly for respiratory conditions.

Variations in the "typical pattern" for Map A included: 1) both metro-center rates below provincial rates but the Metro-Calgary rates higher than the Metro-Edmonton rates, and 2) both metro-center rates very close to provincial rates. The latter pattern was seen in the fractures and lacerations, and perinatal disorder categories. The former pattern was seen in the tonsillitis and the asthma and bronchitis categories.

The typical pattern of regional variation for the Map B aggregation was when the North rates were higher, and South rates lower, than the provincial rates. This pattern was seen for all DAYS combined, intestinal infections, acute respiratory illnesses, pneumonia, asthma and bronchitis, otitis media, and burns. It was suggested that DAY rates for residents of the North region were higher due to harsher climatic conditions and/or greater travel distances to care centers.

The main variation in the typical pattern for Map B was that North and South rates were, for some categories, not substantially different from the provincial rates or from each other. This pattern was seen for tonsillitis, fractures and lacerations, congenital anomalies and perinatal disorders. These diseases would unlikely be affected by climatic conditions (except perhaps tonsillitis). This assumption would suggest that climatic conditions were perhaps a major influence in regional rate variations for the other disease categories.

The typical pattern of regional variation for the Map C aggregate was when the Metropolitan rates were lower than the provincial rates, the Rural rates well above the provincial rates, and the Regional rates somewhere in between and usually relatively close to the provincial rates. This pattern was seen for all the diagnostic categories except congenital anomalies for which there was very little regional variation among rates and all were relatively close to provincial rates. It was suggested that the rate patterns for all three areas were due to factors related to accessibility of care and varying levels of care available within the regions of residence.

There was no entirely typical pattern of regional rate variation for the Map D aggregation. There were however, some recurring relationships. Notably, the Calgary region often had the lowest regional rates. Diagnostic categories which had Calgary regional rates well below provincial levels and other regional rates included: acute respiratory illnesses, asthma and bronchitis, tonsillitis, otitis media, and burns. Grande Prairie, on the other hand, often had the highest regional rates; well above the provincial rates. This was true for all categories except congenital anomalies and fractures and lacerations where there was no consistent pattern of variation among regional rates.

4.5 Patient Origin-Destination Studies

Patient origin-destination analyses were carried out for three large diagnostic categories and a category for all diseases combined. The three large categories were composites of ten of the original sixteen categories. The composite respiratory illness category subsumed acute respiratory infections and influenza, pneumonia, and asthma and bronchitis. This composite category was intended to represent illnesses which could usually be treated in primary care centers and would only occasionally be referred to secondary or tertiary care centers. The composite trauma category was composed of skull fractures, other fractures, lacerations, and burns. This category was intended to represent illnesses which could be treated in primary care centers but were often referred to secondary care centers, and only occasionally referred to tertiary centers. The composite congenital disorders category included congenital heart anomalies, other congenital anomalies and perinatal disorders. This category was intended to represent illnesses which usually required treatment in tertiary care centers.

Results of the patient origin-destination analyses are presented according to the investigational perspectives of: 1) the district of residence--patient origin, and

2) the hospital of service--patient destination.

4.5.1 District Perspective Analyses

Analyses of relevance indices for certain groups of hospital districts were divided into three parts: 1) the influence of hospital size, as measured by the number of rated beds, on patient movement, 2) the influence of levels of care available in the district on patient movement, and 3) the influence of geographic region on patient movement. Results of district perspective analyses are presented below according to these divisions.

Hospital Size

Examination of four groups of hospital districts, grouped according to the number of rated beds in the largest hospital within the district, revealed that as hospital size increased, so did the percentage of district residents staying within their home district for pediatric care. This was an expected finding under the assumption that patients travel to other centers primarily to obtain higher levels of care or a broader spectrum of hospital services; either of which is usually provided by larger hospitals. In districts with a hospital of 500 or more beds, 96% of the district SEPS, over the ten years, stayed within the district for all types of pediatric hospital care (see Table 14). In contrast, districts with a hospital of less than 100 beds had only 71% of the

Table 14

Relevance Indices[1] to Patients' Own[2] District Hospital(s) by Composite Diagnostic Category and Hospital Size

Size of Largest District Hospital in Rated Beds		All Diagnoses	Respiratory	Trauma	Congenital
over 500	SEPS %	96.1	93.9	93.8	99.6
	DAYS %	97.1	94.5	97.3	99.6
100 - 499	SEPS %	81.6	87.7	83.2	50.8
	DAYS %	76.0	88.9	79.6	38.9
50 - 99	SEPS %	71.4	78.9	73.8	20.7
	DAYS %	62.5	76.8	57.5	11.8
under 50	SEPS %	73.1	83.5	70.5	16.6
	DAYS %	63.1	79.2	51.7	9.8

[1] Indices are calculated in separations and patient-days for all years combined.

[2] A patient's "own" hospital is located within the patient's district of residence.

district SEPS stay within the district for pediatric care.

Examination of relevance indices within different diagnostic categories suggested that this pattern was magnified in secondary and tertiary type illnesses. In the congenital category for example, districts with a hospital of 500 or more beds had nearly 100% of the district SEPS stay within the district for care, while districts with a hospital of less than 50 beds had only 17% of the district SEPS stay within the district for care. Again, this finding was expected in that many smaller hospitals have neither adequate facilities nor specially trained medical personnel required to diagnose and treat many congenital conditions. Consequently, the 17% within district SEPS may only represent brief admissions with transfer to a major center for the actual medical care.

The relevance indices calculated in DAYS demonstrated the same patterns, albeit somewhat more pronounced, for all diagnostic categories.

Levels of Care

The relevance indices calculated for Metropolitan, Regional, and Rural areas, for all ten years combined, are presented in Table 15. In general, most pediatric patients received their care in hospitals located within their resident area. This was an expected result in light

Table 15

Relevance Indices[1] of Area Patients to Their Own[2] and Other Area Hospitals by Composite Diagnostic Categories

Measure	Area of Patient Origin	Patient Destination Metropolitan				Regional				Rural			
		Resp	Trau	Cong	All	Resp	Trau	Cong	All	Resp	Trau	Cong	All
SEPS %	Metropolitan	94	94	100	96	0	0	0	0	6	6	0	4
	Regional	1	4	40	6	91	87	59	87	8	9	1	7
	Rural	5	15	68	14	2	4	10	4	93	81	22	82
DAYS %	Metropolitan	95	97	100	97	0	0	0	0	5	3	0	3
	Regional	2	10	59	16	92	85	41	79	6	5	0	5
	Rural	6	30	77	23	2	6	8	3	92	64	15	74
ALOS (days)	Metropolitan	5.8	5.9	9.1	5.8	3.2	2.8	5.1	3.2	5.3	2.4	5.0	4.3
	Regional	8.3	12.9	13.8	12.5	5.4	4.8	6.5	4.6	4.6	2.5	4.0	3.6
	Rural	8.5	10.6	11.5	9.5	6.6	7.8	7.7	5.6	6.3	4.1	6.9	5.5

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[1] Indices are calculated in separations and patient-days for all years combined.

[2] A patient's "own" hospital is located within the patient's area of residence.

of the literature demonstrating the importance of distance minimization in care-seeking behavior. It was also expected that the tendency to stay within the district of origin would decrease for disease categories which required relatively specialized treatment. Such a shift was likely to represent the tendency to refer tertiary cases to Metropolitan hospitals. The congenital disorder category, in fact, illustrated this shift in typical patient destinations, from local hospitals to metropolitan hospitals. A similar, but smaller, shift was also observed for the traumatic injury category.

Upon examination of relevance indices for all patient days combined, it appeared that the tendency to leave the resident district for pediatric care was greatest for Rural residents and smallest for Metropolitan residents. Again, this was an expected finding as the full scope of service provision (primary, secondary, and tertiary care) within Metropolitan areas likely minimized the need for travel. The small proportion of Metropolitan residents treated in Rural hospitals likely lived on the outskirts of Edmonton or Calgary, and chose to travel to a nearby rural hospital, particularly for relatively minor illnesses, or perhaps saw physicians who admitted patients only to the smaller rural hospitals.

Rural residents who sought treatment outside Rural areas travelled primarily to Metropolitan hospitals.

This pattern existed regardless of the nature of the disease. It had been expected that Rural residents, with respiratory illnesses for example, who travelled to other hospitals, would favor Regional hospitals. Instead, Rural residents tended to bypass Regional hospitals when seeking a hospital offering a higher level of care. Interpretation of this trend must be cautious however because such a pattern could simply reflect medical referral patterns, or travel patterns encouraged by major transportation routes.

Regional residents who sought treatment outside Regional areas tended to use Metropolitan hospitals for severe or complex diseases such as congenital disorders, and tended to use Rural hospitals for less severe diseases such as respiratory illnesses.

Examination of patient movement in terms of DAYS, as opposed to SEPS, weighted the relevance indices by the ALOS and therefore tended to exaggerate the patterns described above. For example, congenital disorder DAYS accumulated by Rural residents in Metropolitan hospitals accounted for 77% of all Rural congenital DAYS. In comparison, only 68% of all congenital Rural SEPS were treated in Metropolitan hospitals. The reverse was true, due to a relatively low ALOS, for Regional residents travelling to Rural hospitals for respiratory illnesses or traumatic injuries.

Relevance indices calculated in DAYS for all diseases combined, for years 1971, 1976, and 1980/81 are presented in Table 16. From this comparison it appeared that, over time, a decreasing percentage of all Rural DAYS were being accumulated in Rural hospitals. The Rural patients were instead accumulating an increasing proportion of DAYS in Metropolitan hospitals over the ten years; 16% in 1971, 24% in 1976, and 27% in 1980/81. The relative increase in Rural DAYS from Regional hospitals was, by contrast, only minimal. The apparent increase in Rural children receiving care in Metropolitan hospitals could be due to a number of factors. Rural beds for example may have been increasingly occupied by the aged or patients with chronic care needs. Declining confidence in Rural hospital capabilities, particularly in the wake of new medical technologies, may also have encouraged the movement of Rural patients outside their districts.

The proportion of all Regional DAYS accumulated in Regional hospitals also decreased over time with the main decrease occurring between 1971 and 1976. On the other hand, the proportion of all Regional DAYS accumulated in Metropolitan hospitals increased from 11% in 1971 to 17% in 1980/81. Relevance indices of Metropolitan resident DAYS in Metropolitan hospitals remained relatively stable over time.

As noted above, some of the variation in relevance indices calculated in DAYS could be due to variation in

Table 16

Relevance Indices[1] (Patient-days) for Area Patients to Their Own[2] and Other Area Hospitals for Selected Years[3]

Area of Patient Origin	Patient Destination Metropolitan				Regional				Rural			
	1971	1976	1980/81	1971-1980/81	1971	1976	1980/81	1971-1980/81	1971	1976	1980/81	1971-1980/81
Metropolitan	97	97	98	97	0	0	0	0	3	3	2	3
Regional	11	17	17	16	84	78	78	79	5	5	5	5
Rural	16	24	27	22	3	3	4	4	81	72	69	74

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[1] Indices are calculated for all diagnoses combined.

[2] A patient's "own" hospital is located within the patient's area of residence.

[3] Selected years for this table include 1971, 1976, 1980/81 and 1971 through 1980/81 combined.

the ALOS. Although ALOS was not examined for individual years, the ten year average for ALOS was compared for patients who tended to stay in their resident areas for care, or alternatively, leave their resident areas for care. As expected, patients who travelled to areas where higher levels of care were available tended to have longer ALOS levels than those being treated in their resident district area (see Table 15).

For the congenital disorders category, where a large proportion of the patients would typically travel to areas where relatively specialized services were available, the ALOS levels were typically longest. Of patients who travelled to care, trauma diseases had the next highest ALOS levels, followed closely by the category for all diseases combined. The respiratory illnesses category had the lowest ALOS levels. The trend was magnified when Metropolitan hospital destinations were divided into referral hospitals (UAH and Foothills) and other Metropolitan hospitals (not shown in table). In other words, patients who travelled to one of the two referral hospitals tended to have ALOS longer than any other group.

Rural patients travelling to Regional hospitals, by definition were travelling to areas with higher levels of care than were available in their district of residence. It was expected that their ALOS would be longer than Rural patients who remained in Rural area hospitals. This was true for the trauma and congenital disorders categories. For respiratory illnesses, and all diseases combined however, the ALOS levels were similar for Rural patients in both Rural and Regional hospitals.

For patients who travelled to hospitals with lower levels of service than were available in their residence areas, their ALOS levels were consistently lower than those for patients treated in their own area. For example, regional residents travelling to Rural areas had an ALOS of 3.6 days (for all diseases combined) while Regional residents treated in Regional areas had an ALOS of 4.6 days. This pattern was suggestive of tentative admissions or emergency admissions to small Rural hospitals with subsequent transfer to larger hospitals.

Geographic Regions

Relevance indices in terms of SEPS for the six provincial regions are presented in Table 17 for all diagnoses combined and Table 18 for the three composite diagnostic categories. The corresponding relevance indices in terms of DAYS are presented in Appendix F. For all diagnoses combined, residents tended to stay within their regions for pediatric care. Among the Edmonton and Calgary region residents, 99% and 95% of all pediatric SEPS respectively, were treated in the Edmonton or Calgary regions. Relevance indices for residents of the Lethbridge, Medicine Hat, or Red Deer regions were not much lower. However, for

Table 17

Relevance Indices[1] (Separations) and Average Lengths of Stay for Regional Patients in Their Own[2] and Other Regional Hospitals

Region of Patient Origin		Region of Patient Destination					
		Edm	Calg	Gr.Pr.	Leth.	Med.Ht	Rd.Dr.
SEPS %	Edm	99	0	0	0	0	0
	Calg	2	95	0	1	1	1
	Gr.Pr	22	21	57	0	0	0
	Leth	3	8	0	89	0	0
	Med.Ht	1	6	0	4	89	0
	Rd.Dr	9	4	0	0	0	87
ALOS	Edm	6.1	5.2	5.1	3.8	3.7	5.4
	Calg	4.9	5.5	3.9	4.6	4.0	5.1
	Gr.Pr.	7.3	7.4	5.2	3.1	1.7	3.4
	Leth	4.2	10.3	1.6	4.5	3.9	3.7
	Med.Ht	7.5	14.1	3.0	4.9	3.8	2.5
	Rd.Dr	8.1	6.7	4.1	4.2	2.3	4.6

[1] Indices are calculated for all years combined and for all diagnoses combined.

[2] A patient's "own" hospital is located within the patient's region of residence.

Table 18

Relevance Indices[1] (Separations) and Average Lengths of Stay for Regional Patients in their Own[2] and other Regional Hospitals by Composite Diagnostic Category

Region of Origin	Region of Destination																	
	Edm			Calg			Gr.Pr			Leth			Med.Ht			Rd.Dr		
	Resp	Trau	Cong	Resp	Trau	Cong	Resp	Trau	Cong	Resp	Trau	Cong	Resp	Trau	Cong	Resp	Trau	Cong
SEPS %																		
Edm	99	98	99	0	1	1	0	0	0	0	0	0	0	0	0	1	1	0
Calg	3	2	2	95	95	94	0	0	0	1	1	1	1	0	1	1	2	2
Gr.Pr.	15	24	69	27	14	3	58	62	18	0	0	0	0	0	0	0	0	0
Leth	2	4	5	8	9	28	0	0	0	90	87	67	0	0	0	0	0	0
Med.Ht	1	0	3	1	4	42	0	0	0	3	4	7	95	92	48	0	0	0
Rd.Dr	6	7	32	3	5	8	0	0	0	0	0	0	0	0	0	91	88	60
ALOS																		
Edm	6.7	5.4	9.2	4.1	4.1	7.4	5.6	6.7	7.5	3.6	3.3	2.3	2.6	2.2	5.0	6.1	5.9	7.7
Calg	4.4	3.4	10.3	5.4	5.4	9.9	4.5	3.8	0	5.3	4.9	6.8	4.9	6.3	8.8	5.7	6.5	7.2
Gr.Pr	6.3	6.5	11.8	9.0	4.7	6.2	6.3	4.4	6.0	2.8	0	0	3.0	0	0	2.8	1.2	0
Leth	4.0	2.6	11.0	6.6	8.2	18.1	1.5	1.5	0	5.2	4.9	7.1	5.0	2.7	1.7	2.8	3.5	0
Med.Ht	3.1	1.8	11.9	6.3	13.0	16.0	3.0	0	0	5.6	5.1	6.7	4.4	3.7	5.9	4.3	1.0	3.0
Rd.Dr	5.6	8.3	12.3	5.5	7.7	11.5	4.8	1.5	0	2.7	10.4	11.0	2.4	2.0	0	5.2	4.9	6.7

[1] Indices are calculated for all years combined.

[2] A patient's "own" hospital is located within the patient's region of residence.

residents of the Grande Prairie region, only 57% of all pediatric SEPS were treated in the Grande Prairie region.

Edmonton and Calgary regional residents tended to stay in their resident regions regardless of the nature of the disease. Relevance indices for the other four regions however were more sensitive to the diagnostic category being examined. Grande Prairie residents for example, travelled almost exclusively (69% of the SEPS) to Edmonton for congenital disorders, and to a large extent (23% of the SEPS) for traumatic injuries. For respiratory illnesses however, Grande Prairie residents tended to travel to Calgary (27% of SEPS). As in subsequent hospital perspective analyses, these Grande Prairie-Calgary SEPS were thought to be concentrated in the Alberta Children's Hospital. The reason for this pattern of movement was not known. For residents of the Lethbridge region, the proportion of congenital SEPS (28%) travelling to Calgary was greater than the proportions of trauma SEPS (9%) or of respiratory SEPS (8%) travelling to Calgary. Similar patterns of movement with respect to diagnostic categories was seen for residents of the Medicine Hat and Red Deer regions.

The ALOS levels, for all diseases combined (see Table 17), were compared between residents staying within their home region, and residents travelling outside their home region for pediatric care. Of the residents remaining in their home region, Edmonton residents had the highest ALOS levels at 6.1 days. Calgary residents followed with 5.5 days, then Grande Prairie residents with 5.2 days, Red Deer residents with 4.6 days, Lethbridge residents with 4.5 days, and finally Medicine Hat residents with 3.8 days. For residents travelling to other regions for care, their ALOS levels were generally higher than ALOS levels for residents remaining within their regions. In some cases the differences were substantial. Medicine Hat and Lethbridge residents for example, who travelled to Calgary had ALOS levels of 14.1 days and 10.3 days respectively. Residents of the Red Deer region who travelled to Edmonton and Calgary averaged ALOS levels of 8.1 days and 6.7 days respectively, while residents who stayed within Red Deer averaged an ALOS of 4.6.

The longer ALOS's for patients who travelled to care was expected under the assumption that they travelled primarily to obtain a higher level of service, presumably for more complex diseases, than was available in their home district. It was surprising, however, that patients from the Red Deer region had longer ALOS's in Calgary region hospitals than in Edmonton region hospitals. It seemed unlikely that patterns of practice were so different in the two major centers as to differ in average lengths of stay by two and a half days. One possibility was that patients with the more complex, resource intensive, diseases travelled to Calgary. However, only 8% of the Red Deer congenital anomalies SEPS were attributed to Calgary hospitals while 32% were attributed to Edmonton hospitals. In addition, the ALOS for Red Deer congenital anomalies in Calgary hospitals was 11.5 days while the ALOS in Edmonton hospitals was 12.3 days (see Table 18). Another possibility was that Calgary hospitals such as the Alberta Childrens Hospital tended to provide more rehabilitation services or longer term care that forced the average length of stay higher. To confirm or refute this hypothesis, examination of patient movement from a hospital perspective was required.

4.5.2 Hospital Perspective Analyses

Analyses of commitment indices for hospitals and hospital groups were divided into three parts: 1) examination of individual hospitals in Edmonton and Calgary, 2) examination of hospitals grouped by levels of care, and 3) examination of hospital groups according to the six provincial regions described for Map D. The results are presented below according to the same divisions.

Edmonton and Calgary Hospitals

The commitment indices for individual hospitals in Edmonton, for all ten years combined are presented in Table 19 for all diagnoses combined and in Table 20

Table 19

Commitment Indices[1] of Edmonton Hospitals to Residents of Selected Areas and Average Lengths of Stay

		Patient-Origin	
Hosp[2]	Metro-Edmonton	Surrounding[3]	Elsewhere
SEPS %			
UAH	56	8	36
RAH	78	8	14
MIS	77	14	9
EDG	82	8	10
CAM	59	14	27
CRO	39	8	53
DAYS %			
UAH	42	8	50
RAH	70	8	22
MIS	72	15	13
EDG	80	7	13
CAM	44	16	40
CRO	37	6	57
ALOS			
UAH	7.1	9.0	12.9
RAH	5.7	6.2	9.6
MIS	5.7	5.9	9.0
EDG	4.9	4.5	6.4
CAM	6.1	10.6	12.1
CRO	8.6	7.7	9.8

[1] Commitment indices are calculated in separations and patient-days for all years combined and for all diagnoses combined.

[2] Hospital names and abbreviations are listed in Appendix G.

[3] Surrounding areas include Devon, Ft. Saskatchewan, Leduc, Sturgeon, and Stony Plain.

Table 20

Commitment Indices[1] by Edmonton Hospitals[2] to Residents of Selected Areas and Average Lengths of Stay by Composite Diagnostic Categories

Hosp[3]	Metro-Edmonton Resp	Metro-Edmonton Trau	Metro-Edmonton Cong	Patient Origin[4] Surrounding Resp	Surrounding Trau	Surrounding Cong	Elsewhere Resp	Elsewhere Trau	Elsewhere Cong
SEPS %									
UAH	75	62	42	6	7	8	19	31	50
RAH	86	81	54	7	6	11	7	13	35
MIS	80	72	65	14	19	13	6	9	22
EDG	90	83	67	6	7	10	4	10	23
CAM	69	61	47	19	14	13	12	25	40
DAYS %									
UAH	61	44	37	6	7	7	33	49	56
RAH	82	74	45	6	8	9	12	18	46
MIS	77	67	59	14	19	13	9	14	28
EDG	89	75	64	6	7	10	5	18	26
CAM	56	38	32	22	13	15	22	49	53
ALOS									
UAH	5.2	6.4	9.1	5.9	9.2	9.3	11.7	14.5	11.8
RAH	5.9	5.8	8.1	5.8	7.6	8.4	10.6	9.0	12.8
MIS	6.0	5.1	7.2	6.1	5.6	8.1	9.9	9.1	10.0

Table 20
(cont'd)

Hosp[3]	Patient Origin								
	Metro-Edmonton			Surrounding[4]			Elsewhere		
	Resp	Trau	Cong	Resp	Trau	Cong	Resp	Trau	Cong
EDG	5.3	5.0	7.6	5.3	5.8	7.7	7.1	10.5	9.4
CAM	7.2	6.3	6.4	10.3	9.0	10.8	15.7	19.1	12.5

[1] Commitment indices are calculated in separations and patient-days for all years combined.

[2] The Cross Cancer Institute is excluded due to its diagnostic specific commitment pattern.

[3] Hospital names and abbreviations are listed in Appendix G.

[4] Surrounding areas include Devon, Ft. Saskatchewan, Leduc, Sturgeon, and Stony Plain.

for the three composite diagnostic categories. Of the Edmonton hospitals, the University of Alberta Hospital (UAH) had the lowest commitment index to Metro-Edmonton residents in each of the diagnostic categories and for all diseases combined. Of all pediatric DAYS accumulated at UAH, over ten years, 50% were committed to residents living beyond Edmonton and its surrounding area (Devon, Fort Saskatchewan, Leduc, Sturgeon and Stony Plain). This commitment level was not necessarily a function of a geographic catchment area because the Royal Alexandra Hospital and the Misericordia Hospital, other Edmonton hospitals with large pediatric services, were committed to residents outside the same area by only 22% and 13% respectively. This pattern was equally evident with indices calculated in terms of SEPS. Therefore, it appeared that the UAH served as the major Edmonton referral center for pediatric cases in Alberta. Any plans to restructure pediatric tertiary referral services in Alberta should take this existing pattern of service into account.

The examination of commitment indices by composite diagnostic categories (in Table 20) provided an even more convincing representation of the UAH as Edmonton's major referral center. The UAH committed 56% of its DAYS and 50% of its SEPS for congenital anomalies to residents of areas beyond Edmonton and the surrounding areas. By comparison, the RAH committed 46% of its DAYS and 35% of its

SEPS to residents beyond the greater Edmonton area. Similar differences were seen for the respiratory and trauma disease categories.

The Charles Camsell Hospital (CAM) and the Cross Cancer Institute (CRO) also committed large portions of their pediatric DAYS (40% and 57% respectively) to children living outside the greater Edmonton area. However, travel to the CAM or the CRO had the very specific determinants of either native status or a malignant diagnosis and was therefore not considered as comparable with travel patterns to other Edmonton hospitals.

Commitment indices for the individual hospitals in Calgary are presented in Table 21 for each composite diagnostic category and for all diagnoses combined.

Among the Calgary hospitals, the highest proportion of pediatric DAYS committed to residents outside the Calgary district was 24%. This level of commitment was shared by the Foothills Provincial Hospital and the Alberta Hospital for Children (AHC). It appeared that these two hospitals served as the pediatric referral centers in Calgary. However, if commitment indices were examined within diagnostic categories, it appeared that only the Foothills functioned in a manner typically consistent with a major referral center. The AHC committed 14% of its respiratory DAYS to residents outside Calgary.

Table 21

Commitment Indices[1] of Calgary Hospitals to Residents of Selected Areas and Average Lengths of Stay

		Patient Origin							
		Metro-Calgary				Elsewhere			
	HOSP[2]	Resp	Trau	Cong	All	Resp	Trau	Cong	All
SEPS %									
	FTH	94	86	65	84	6	14	35	16
	AHC	86	80	76	86	14	20	24	14
	CAG	97	94	88	94	3	6	12	6
	HCH	96	89	77	91	4	11	23	9
	ROC	98	96	92	95	2	4	8	5
	SAL	100	100	100	96	0	0	0	4
DAYS %									
	FTH	92	75	58	76	8	25	42	24
	AHC	85	85	72	76	15	15	28	24
	CAG	96	89	83	92	4	11	17	8
	HCH	94	85	75	88	6	15	25	12
	ROC	98	95	89	95	2	5	11	5
	SAL	100	100	100	97	0	0	0	3
ALOS									
	FTH	5.8	5.5	12.3	7.0	8.4	11.6	16.4	11.6
	AHC	12.7	32.2	10.3	7.0	14.4	22.9	12.4	13.3
	CAG	6.1	5.6	9.1	5.5	8.8	10.8	12.9	8.2

Table 21
(cont'd)

HOSP[2]	Patient Origin							
	Metro-Calgary				Elsewhere			
	Resp	Trau	Cong	All	Resp	Trau	Cong	All
HCH	4.9	5.1	7.4	5.1	6.7	7.4	8.3	6.9
ROC	3.7	3.3	4.7	3.3	3.7	4.1	6.4	3.6
SAL	2.3	3.0	7.3	7.2	-	-	-	-

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[1] Commitment indices are calculated for separations and patient-days for all years combined for each composite diagnostic category and for all diagnoses combined.

[2] Hospital names and abbreviations are listed in Appendix G.

This was much higher than the 8% commitment of the Foothills. This was possibly due to a larger number of chronic respiratory cases in the AHC as was suggested by the relatively long ALOS for the AHC respiratory category. Commitment indices to residents outside Calgary for the trauma and congenital categories were highest for the Foothills. The corresponding indices for the AHC were closer to the indices of the Holy Cross and the Calgary General than they were to the Foothills. The commitment indices for the AHC did not, therefore, follow a pattern characteristic of a major referral center. It could be argued, based on this finding, that the AHC does not function as a major tertiary referral center for pediatrics in Alberta.

Levels of Care

Analyses of commitment indices for Referral (III), Metropolitan (IIb), Regional (IIa), and Rural (I) hospitals indicated that the majority of hospital resources, in terms of SEPS and DAYS, were committed to children living within the hospital area (see Table 22). As expected, this level of commitment varied across the types of hospitals, as classified according to levels of care provided. The Referral hospitals committed 69% of their SEPS and 56% of their DAYS, for all diseases combined, to Metropolitan residents. The remaining Metropolitan based hospitals committed 83% of their SEPS

Table 22

Commitment Indices[1] of Hospitals, by Differing Levels of Care, to Area Residents and Average Lengths of Stay

	Hosp Type[2]	Patient Origin		
		Metropolitan	Regional	Rural
SEPS %	III	69	3	28
	IIb	83	1	16
	IIa	1	79	20
	I	3	1	96
DAYS %	III	56	5	39
	IIb	76	2	22
	IIa	1	76	23
	I	2	1	97
ALOS	III	7.0	12.8	12.0
	IIb	5.5	12.1	8.2
	IIa	3.2	4.6	5.6
	I	4.3	3.6	5.5

[1] Commitment indices are calculated in separations and patient-days for all years combined and all diagnoses combined.

[2] Hospital types: III) the two major Referral hospitals, IIb) other Metropolitan based hospitals, IIa) Regional hospitals, and I) Rural hospitals.

and 76% of their DAYS to Metropolitan children. Regional hospitals were committed to Regional children by similar proportions; 79% of their SEPS and 76% of their DAYS. As expected, these commitment indices suggested that the non-referral Metropolitan hospitals functioned more as local and regional care centers. In contrast, the Referral hospitals were committed to local and area residents to a lesser extent.

To view these commitments from another perspective, the Referral hospitals were committed to Rural children to a relatively large extent (28% of SEPS and 39% of DAYS) as compared to the Metropolitan or Regional hospitals. The only larger commitment to Rural children was, of course, from the Rural hospitals (96% of SEPS and 97% of DAYS). The Referral hospital commitment to Regional children was much smaller than to Rural children. This was, however, in keeping with the population proportions in the province where Regional children contributed only 9.2% to the pediatric population as compared to the 40% contribution of Rural children. The large commitment of Referral hospitals to Regional and Rural children was an expected finding based on the assumptions that hospitals which provide higher levels of care serve a very broad patient constituency. This finding also tended to lend further credence to the designation of the UAH and FTH as the two major referral centers for pediatrics in Alberta.

The commitment indices for hospital groups were examined, in terms of DAYS for all diagnoses combined, over time and are presented in Table 23. The commitment of Referral hospitals to Regional and Rural residents tended to increase over time. The commitment to Rural children increased from 32% in 1971 to 40% in 1976. The increase was not a steady trend, however, and by 1980/81 the Referral hospital commitment to Rural children had dropped slightly to 38% of the hospital's DAYS. The commitment of Metropolitan and Regional hospitals to Rural children also increased over time. The Metropolitan hospitals' commitment of DAYS increased from 15% in 1971 to 26% in 1980/81 with the largest increase occurring between 1971 and 1976. The Regional hospitals steadily increased their commitment to Rural children from 19% in 1971 to 27% in 1980/81. This pattern was in accordance with the Anderson and Wertz (1977) prediction for British Columbia pediatric referral patterns. They predicted that "as secondary referral centers [analogous to Regional hospitals] become more established and specialists become more widely distributed, the tertiary referrals should become more stable" (Anderson & Wertz, 1977, p. 411).

As can be seen from Table 24, the commitment indices of hospital groups with differing levels of care were somewhat dependent on the composite diagnostic categories

Table 23

Commitment Indices[1] (Patient-days) of Hospitals, by Differing Levels of Care, to Area Residents for Selected Years[2]

		Patient Origin								
		Metropolitan			Regional			Rural		
	Hosp Type[3]	71	76	80/81	71	76	80/81	71	76	80/81
DAYS %										
	III	64	55	56	4	5	6	32	40	38
	IIb	84	73	73	1	2	1	15	25	26
	IIa	1	0	0	80	77	73	19	23	27
	I	2	2	2	1	1	1	97	97	97

[1] Commitment indices are calculated in patient-days for all years combined and for all diagnoses combined.

[2] Selected years include 1971, 1976, and 1980/81.

[3] Hospital types: III) the two major Referral hospitals, IIb) other Metropolitan based hospitals, IIa) Regional hospitals, and I) Rural hospitals.

Table 24

Commitment Indices[1] of Hospitals, by Differing Levels of Care, to Area Residents and Average Lengths of Stay for Composite Diagnostic Categories

		Patient Origin								
	Hosp Type[2]	Metropolitan			Regional			Rural		
		Resp	Trau	Cong	Resp	Trau	Cong	Resp	Trau	Cong
SEPS %	III	88	75	49	1	2	7	11	23	44
	IIb	88	84	68	0	1	4	12	15	28
	IIa	1	2	0	87	78	59	12	20	41
	I	3	5	2	1	2	1	96	93	97
DAYS %	III	81	58	45	1	4	9	18	38	46
	IIb	85	78	62	0	1	5	15	21	33
	IIa	1	1	0	85	70	55	14	29	45
	I	2	3	2	1	1	1	97	96	97
ALOS	III	5.6	5.9	10.3	9.1	14.2	14.4	9.8	13.0	12.1
	IIb	5.8	5.9	8.4	7.7	10.8	13.0	8.2	9.2	10.9
	IIa	3.2	2.8	5.1	5.4	4.8	6.5	5.6	7.8	7.7
	I	5.3	2.4	9.1	4.6	2.5	4.0	6.3	4.1	6.9

[1] Commitment indices are calculated in separations and patient-days for all years combined.

[2] Hospital types: III) the two major Referral hospitals, IIb) other Metropolitan based hospitals, IIa) Regional hospitals, and I) Rural hospitals.

being examined. The Referral hospitals, for example, committed 44% of their congenital disorder SEPS, 23% of their trauma SEPS and only 11% of their respiratory SEPS to children living in Rural areas. From this pattern, it seemed that the relatively large commitment of Referral hospital resources to Rural children was primarily for diseases which required relatively specialized care, such as congenital disorders. This, of course, was an expected finding. It was reasonable to expect that the hospitals which provided the major sources of tertiary care in the province would commit relatively large portions of their resources to children beyond the Metropolitan area--to children who were referred for specialized care needs.

The commitment indices of Metropolitan and Regional hospitals to Rural children also tended to increase with increasing complexity of the disease category. Metropolitan hospitals committed 12% of their respiratory SEPS, 15% of their trauma SEPS and 28% of their congenital SEPS to Rural children. Interestingly, the corresponding Regional hospital commitments increased more sharply with increasing disease complexity; from 12% of their respiratory SEPS to 20% of their trauma SEPS and to 41% of their congenital SEPS. This pattern suggested that the Metropolitan and Regional hospitals did not function equally well as secondary referral centers. It could be that the Metropolitan hospitals have to compete, to a certain degree, with the Referral hospitals for referred cases which require secondary level care.

Rural hospitals committed over 95% of their DAYS to Rural children, regardless of the nature of disease. This confirmed the trend seen for relevance indices in that there was virtually no travel from Metropolitan or Regional areas to Rural hospitals. Any such travel could likely be attributed to accidents or illnesses which arose while the child was away from the area of residence; or attributed to children living in suburban areas for which the nearest hospital was designated as a Rural hospital.

Geographic Regions

Commitment indices for hospitals in the six provincial regions, for all years combined and all diseases combined, are presented in Table 25. (The associated lengths of stay are presented in Appendix F). All hospital groups committed at least 89% of their pediatric SEPS (and 88% of their pediatric DAYS) to children living in the hospital region. The Grande Prairie hospitals committed as much as 97% of their pediatric SEPS (and DAYS) to children in the Grande Prairie region.

In addition to the primary commitments each hospital group had to children in their regions, the hospitals also had secondary commitments to children of other regions.

Table 25

Commitment Indices[1] of Regional Hospitals to Their Own[2] and Other Regional Residents

	Patient Origin					
Hosp	Edm	Calg	Gr.Pr.	Leth.	Med.Ht	Rd.Dr.
SEPS %						
Edm	96	1	2	0	0	1
Calg	1	92	4	2	0	1
Gr.Pr	3	0	97	0	0	0
Leth	0	5	0	93	2	0
Med.Ht	0	7	0	1	92	0
Rd.Dr	5	6	0	0	0	89
DAYS %						
Edm	96	1	2	0	0	1
Calg	1	88	5	4	1	1
Gr.Pr.	3	0	97	0	0	0
Leth	0	5	0	93	2	0
Med.Ht	0	7	0	1	92	0
Rd.Dr	6	6	0	0	0	88

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[1] Commitment indices are calculated in separations and patient-days for all years combined and for all diagnoses combined.

[2] A hospital's "own" residents reside in the region where the hospital is located.

The secondary commitments for Edmonton hospitals were, not surprisingly, to the Grande Prairie and Red Deer regions; the two regions which bordered the Edmonton region. Calgary hospitals, on the other hand, were secondarily committed to some extent, in terms of DAYS, to all other regions. The largest such commitment was to Grande Prairie. This confirmed the district perspective analysis which showed relatively high proportions of Grande Prairie children travelling to Calgary for care.

Hospitals in Grande Prairie were secondarily committed to Edmonton region children. In this regard, it should be noted that the Edmonton region included several northern communities, such as High Prairie, which bordered on the Grande Prairie region. Residents of these northern communities may have found it more convenient to travel to Grande Prairie for their pediatric care. Red Deer region hospitals were secondarily committed to children of the surrounding regions of Edmonton and Calgary. Similarly, Lethbridge region hospitals were secondarily committed to residents of the surrounding regions of Calgary and Medicine Hat. Medicine Hat region hospitals committed 7% of their pediatric DAYS to Calgary region children. Again, this commitment was likely principally to nearby communities, such as Brooks, which were categorized in the Calgary region.

Commitment indices subdivided by composite diagnostic categories are presented in Table 26. (The associated average lengths of stay are presented in Appendix F). In most cases, the indices associated with a group of hospital's secondary commitments, such as Edmonton hospitals to Grande Prairie children, tended to increase with the complexity of the disease category. Edmonton region hospitals, for example, committed 1% of their respiratory DAYS, 2% of their trauma DAYS and 5% of their congenital disorder DAYS to children from the Grande Prairie region. A similar pattern of commitment increase was seen for Red Deer region children. One striking exception to this expected pattern however was the commitment of Calgary region hospitals to Grande Prairie region children. The pattern of disease specific commitment was reversed such that 12% of the Calgary hospitals' respiratory DAYS, 1% of the trauma DAYS and 0% of the congenital disorder DAYS were committed to Grande Prairie region children. There was no immediately obvious reason why so many Calgary respiratory DAYS would be committed to children that would have to bypass Edmonton enroute to Calgary. However, the ACH in Calgary did have several outreach physiotherapy and rehabilitative programs during the study period from 1971 to 1980/81. These programs were directed toward respiratory and orthopedic conditions. Admissions for chronic and rehabilitative treatment at the ACH could have inflated the Calgary commitment to

Table 26

Commitment Indices[1] of Regional Hospitals to Their Own[2] and Other Regional Residents for Composite Diagnostic Categories

	Patient Origin																	
Hosp	Edm			Calg			Gr.Pr			Leth			Med.Ht			Rd.Dr		
	Resp	Trau	Cong	Resp	Trau	Cong	Resp	Trau	Cong	Resp	Trau	Cong	Resp	Trau	Cong	Resp	Trau	Cong
SEPS %																		
Edm	97	96	91	1	1	1	1	2	4	0	0	1	0	0	0	1	1	3
Calg	1	2	1	89	93	89	7	2	0	2	2	6	0	0	3	1	1	1
Gr.Pr	2	5	8	0	1	0	98	94	92	0	0	0	0	0	0	0	0	0
Leth	1	1	0	4	5	8	0	0	0	94	92	89	1	2	3	0	0	0
Med.Ht	1	1	0	3	5	18	0	0	0	1	0	1	95	94	81	0	0	0
Rd.Dr	6	6	6	4	8	14	0	0	0	0	0	0	0	0	0	90	86	80
DAYS %																		
Edm	97	96	88	1	1	1	1	2	5	0	0	1	0	0	0	1	1	5
Calg	0	1	1	84	92	83	12	1	0	3	3	9	0	1	5	1	2	2
Gr.Pr	2	8	10	0	0	0	98	92	90	0	0	0	0	0	0	0	0	0
Leth	1	1	0	4	5	8	0	0	0	94	92	89	1	2	3	0	0	0
Med.Ht	0	1	0	4	9	25	0	0	0	1	0	0	95	90	75	0	0	0
Rd.Dr	7	7	7	4	10	14	0	0	0	0	0	0	0	0	0	89	83	79

[1] Commitment indices are calculated in separations and patient-days for all years combined.

[2] A hospital's "own" residents reside in the region where the hospital is located.

"outreach" areas. Evidence of chronic type care for respiratory illnesses can be found in the Table for regional ALOS levels in Appendix F. It shows an ALOS of 9 days for Grande Prairie children with respiratory illnesses in Calgary hospitals.

4.5.3 Summary

The district perspective analyses examined patient movement through district relevance indices. Three different analyses grouped districts according to the following criteria: size of largest hospital, highest level of care available and geographic region. The first analysis revealed, as expected, that as the hospital size increased so did the percentage of district residents staying within their home district for pediatric care. This pattern was found to be magnified in the diagnostic categories which represented secondary (trauma) and tertiary (congenital) type illnesses.

The second analysis was based on the Metropolitan-Regional-Rural district aggregate which was assumed to represent degrees in the levels of care available in the districts. As expected, most pediatric patients received their care in hospitals located within their resident area. For congenital disorders, however, the typical patient destination shifted from local hospitals to Metropolitan hospitals, where specialized tertiary care was offered. In general, the tendency to leave the resident district, for any level of pediatric care, was greatest for Rural residents and smallest for Metropolitan residents. Rural residents who sought treatment outside Rural areas travelled primarily to Metropolitan hospitals, regardless of the disease involved. Over time, it appeared that an increasing portion of all Rural DAYS were being accumulated in Metropolitan hospitals. As expected, patients who travelled to areas where higher levels of care were available, and particularly to Referral hospitals, tended to have longer ALOS's than those being treated in their resident areas.

The third analysis was based on the six regional geographic district aggregations. The relevance indices of most regions indicated that at least 85% of all the pediatric SEPS accumulated by a given region actually occurred in that region. The major exception was the Grande Prairie region, with only 57% of all its pediatric SEPS occurring in Grande Prairie. The proportion of patients travelling beyond their resident region for care generally varied with diagnostic categories, except for the Edmonton and Calgary region residents who tended to remain in their own regions. An unexpected finding, for which there was no definitive explanation, was that 27% of the Grande Prairie respiratory SEPS, occurred in Calgary region hospitals. Patients who did travel to other regions for care typically had longer ALOS's than patients who remained in their resident regions for the same type of illness.

From the hospital perspective, commitment indices for hospitals and hospital groups were examined through analyses of the following: individual Edmonton and Calgary hospitals, hospitals grouped by levels of care and, hospitals grouped by geographic region. The first analysis found evidence to suggest that the UAH was the major Edmonton based referral center for pediatric cases in Alberta between 1971 and 1980/81. Similarly, the FTH was found to be the major Calgary based referral center for pediatric cases in Alberta between 1971 and 1980/81.

The second analysis found that, as expected, the level of commitment to area residents varied across the groups of hospitals, as classified according to levels of care. The Referral hospitals (tertiary care), for example, committed only 56% of their DAYS to Metropolitan children as compared to 76% commitment of other Metropolitan hospital DAYS to Metropolitan children. Over time, the Referral, Metropolitan and Regional (tertiary and secondary care) hospitals increased their commitments to Rural children. The pattern of increase suggested that Referral and Metropolitan commitment increases have levelled off while the increase in Regional hospital commitment to Rural children continues to rise. These commitment indices were also sensitive to diagnostic categories. Commitment to children living outside the hospitals' region, for example, tended to increase with increasing complexity in the disease category. Examination of commitments relative to disease categories suggested that Metropolitan and Regional hospitals did not function equivalently as secondary referral centers.

The third analysis confirmed the earlier finding that hospital groups committed the majority of pediatric SEPS (at least 89% in this analysis) to children living within the hospital region. Hospital groups were also secondarily committed to other geographic regions. Calgary region hospitals were committed, in terms of DAYS, to all the other regions, including a surprisingly large commitment to Grande Prairie region children. Secondary commitments, when subdivided by diagnostic category, tended to increase with increasing complexity of the disease. Again, the exception to this pattern was the relatively high commitment of Calgary hospital respiratory DAYS to children in the Grande Prairie region. This pattern may have been due partially to an asthma education and rehabilitation program offered at the ACH during the study period.

4.6 Pediatric Utilization by Levels of Care

Utilization of pediatric DAYS was analysed by levels of care for all ten years of the study period combined and for the most recent year of available data, 1980/81. The estimates of DAYS attributable to different levels of care, rather than to hospitals or districts, were developed through the application of several assumptions to patient flow matrices. The assumptions regarding patient flow were that: 1) patient outflow from Regional areas to Metropolitan area hospitals was entirely due to tertiary (III) care requirements, 2) patient outflow from Rural areas could be due to either tertiary (III) or secondary (II) level of care requirements and, 3) all primary (I) care requirements for Rural patients could be satisfied in Rural area hospitals.

By applying the patient flow assumptions to the flow matrix for 1971-1980/81, presented in Table 27, it was concluded that 52,786 Regional DAYS could be attributed to tertiary care requirements in Regional areas. Similarly, 1,744,282 Rural DAYS could be attributed to primary care requirements while the remaining 616,975 Rural DAYS could be attributed to either secondary or tertiary level care requirements in the Rural areas.

The above information was used to develop estimates of utilization by levels of care for the entire province. These estimates were based on the assumption that requirements for tertiary and secondary care, in terms of DAYS per 1000 children-year, were uniform across the province. In other words, variations in DAY rates, for all diseases combined, were due exclusively to variations in

Table 27

Total Patient-days[1] by Area of Patient Origin and Destination for 1971 through 1980/81

Patient Destination	Area of Patient Origin			
	Metropolitan	Regional	Rural	Alberta
Metro	1,358,375	52,786	536,692	1,947,853
Reg	1,852	264,877	80,283	347,012
Rural	38,003	16,587	1,744,282	1,798,872
All	1,398,230	334,250	2,361,257	4,093,737
Service Population	2,643,632	475,065	2,015,123	5,133,820

[1] Total patient-days represents all diagnoses combined.

primary care requirements. By virtue of this assumption, the Regional DAYS attributed to tertiary care, when expressed in terms of a rate, could also represent tertiary care requirements in the Metropolitan and Rural areas.

In Table 28, the DAY rate for Regional tertiary care utilization, 111.1 DAYS per 1000 children-year, was applied across the province. The number of DAYS of tertiary care in the Metropolitan and Rural areas was then derived from the tertiary care rate. Similarly, DAY rate for Rural secondary care utilization, 195.1 DAYS per 1000 children-year, was applied across the province. The DAY rate for secondary care was calculated as the total Rural DAY rate minus the primary care Rural DAY rate minus the Regional tertiary care rate, which also applied to the Rural area. Knowing these component rates and the total utilization rates, the remainder of the matrix could be completed. The provincial DAY rate for all ten years combined was 797.4 DAYS per 1000 children-year. Of this level of utilization, 111.1 DAYS per 1000 children-year (570,435 DAYS in total) were attributed to tertiary care, 195.1 DAYS per 1000 children-year (1,001,399 DAYS in total) to secondary level care, and 491.2 DAYS per 1000 children-years (2,521,903 DAYS in total) to primary level care in Alberta.

The estimates of tertiary care utilization were translated into tertiary bed requirements (based on use

Table 28

Patient-days and utilization Rates[1] for Three Levels of Care by Area of Patient Origin for 1971 Through 1980/81

Level of Care			Area of Patient Origin		
		Metropolitan	Regional	Rural	Alberta
III	Rate	111.1	111.1	111.1	111.1
	DAYS	293,742	52,786	223,907	570,435
II	Rate	195.1	195.1	195.1	195.1
	DAYS	515,665	92,666	393,068	1,001,399
I	Rate	222.7	397.4	865.6	491.2
	DAYS	588,823	188,798	1,744,282	2,521,903
All	Rate	528.9	703.6	1171.8	797.4
	DAYS	1,398,230	334,250	2,361.257	4,093,737
Service[2] Population		2,643,632	475,065	2,015,123	5,133,820

[1] Rates are in units of patient-days per 1000 children (pediatric service population) and are calculated for all years combined and for all diagnoses combined.

[2] Pediatric service population is aggregated over 1971 through 1980/81.

rather than "need") for Alberta. Based on the experience over the ten years between 1971-1980/81, approximately 184 tertiary care beds, at 85% occupancy, were required throughout Alberta. The calculation was:

$$\frac{\text{570,435 tertiary patient (bed) days} \div \text{10 years}}{\text{365 available days per year X .85 bed occupancy}} = \text{183.9 beds}$$

When the above analysis was repeated using only 1980/81 data, the resulting estimates were somewhat lower for the rates by levels of care and for tertiary bed requirements.

The patient flow patterns, in terms of DAYS, are presented in Table 29 while the utilization patterns by levels of care are presented in Table 30. The provincial DAY rate for 1980/81 was 543.3 DAYS per 1000 children. Of this level of utilization, 80.3 DAYS per 1000 children (44,916 DAYS in total) were attributed to tertiary care, 155.4 DAYS per 1000 children (86,853 DAYS in total) were attributed to secondary care, and 307.6 DAYS per 1000 children (171, 970 DAYS in total) were attributed to primary level care in Alberta. The lower rates were expected in view of the general decline in pediatric utilization over time. The lowest level of pediatric utilization in the ten year study period was the 1980/81 year.

Based on the 1980/81 estimates for tertiary care utilization, approximately 145 tertiary care pediatric

Table 29

Total Patient-days[1] by Area of Patient Origin and Destination for 1980/81

Destination	Metropolitan	Regional	Rural	Alberta
Metro	100,919	4,435	45,705	151,059
Reg	127	20,541	7,484	28,152
Rural	2,544	1,256	120,728	124,528
All	130,590	26,232	173,917	303,739
Service Population	278,201	55,202	225,677	559,080

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[1] Total patient-days represents all diagnoses combined.

Table 30

Patient Days and Utilization Rates[1] for Three Levels of Care by Area of Patient Origin for 1980/81

Level of Care		Metropolitan	Regional	Rural	Alberta
III	Rate	80.3	80.3	80.3	80.3
	DAYS	22,350	4,435	18,131	44,916
II	Rate	155.4	155.4	155.4	155.4
	DAYS	43,218	8,576	35,059	86,853
I	Rate	136.7	239.5	534.9	307.6
	DAYS	38,022	13,221	120,727	171,970
All	Rate	372.4	475.2	770.6	543.3
	DAYS	103,590	26,232	173,917	303,739
Service Population		278,201	55,202	225,677	559,080

[1] Rates are in units of patient-days per 1000 children (1980/81 pediatric service population) and are calculated for all diagnoses combined.

beds, at 85% occupancy were "required" in Alberta during that period. The calculation was:

$$\frac{\text{44,916 tertiary patient (bed) days}}{\text{365 available days X .85 bed occupancy}} = \text{144.8 beds}$$

The debatable component of the bed requirement calculation is the occupancy rate. If lower occupancy rates were used in the above calculations, the estimated tertiary bed requirements would increase. For example, the 1980/81 tertiary DAYS would require 154 beds if an 80% occupancy rate was used in the calculation. Occupancy rates for children's hospital beds have traditionally been notoriously low particularly when all levels of care are included in the service. However, if pediatric services become more centralized over time, as have many other medical services, then it would be reasonable to expect some increase in typical occupancy rates for tertiary beds as a result of greater averaging of volume fluctuations. For planning purposes, therefore, it is likely wise to opt for the optimum occupancy level. For the sake of comparison however, Appendix H contains a table of estimates for tertiary bed requirements, based on the 1980/81 data, as they relate to varying occupancy rates.

In summary, the 1980/81 pediatric utilization data for acute care hospitals indicates that 145 pediatric beds are required for meeting the pediatric tertiary care "needs" in Alberta. The distribution of these beds across the province and among specific hospitals is a matter of policy and is, therefore, not addressed in this analysis.

4.7 Chapter Summary

Results of the analyses were presented according to the five steps in the analytical pathway described in Chapter III. As an introduction, however, a profile of the Alberta health care system was presented. It reviewed structural components of the system such as districts, hospitals, and beds, and dynamic components of the system such as physicians and service populations. Of note was the fact that pediatric beds in the province declined nearly 11% (207 beds) between 1971 and 1979/80, while during the same time the total number of acute care beds increased by approximately 4% (509 beds). The largest decline was experienced in Edmonton hospitals, but Edmonton continued to have more pediatric beds than Calgary.

Provincial trends in pediatric utilization reflected the national pattern of declining utilization rates over time and relatively high levels of utilization for children under one year of age. Among the selected diagnostic categories, utilization attributed to tonsillitis decreased dramatically over the study period while utilization attributed to perinatal disorders increased dramatically. Provincial utilization rates for all selected diagnoses were higher than corresponding Canadian rates for 1978. Similarly, Alberta rates were typically higher than the corresponding American rates for 1979/80. The limitations of these comparisons were discussed in the main text.

District level analyses demonstrated extreme variations in district utilization rates. Distributions of district utilization rates, therefore, tended to be strongly skewed to the right although no districts had consistently extreme rates. In most cases, major population centers had relatively low rates such that 60 to 70% of the province's service population was residing in districts with utilization rates which were below the provincial rate. In support, when rate levels were geographically mapped, the northern districts had relatively high utilization rates while the major population centers of Edmonton and Calgary had relatively low rates.

Individual districts were aggregated into four regional configurations referred to as Map A, B, C, and D. The typical pattern of regional rate variation for Map A was that both Metro-Edmonton and Metro-Calgary rates were below the provincial rates over time. In addition, Metro-Edmonton rates were typically somewhat higher than Metro-Calgary rates due, possibly, to the larger number of pediatric beds per 1000 children in Edmonton as compared with Calgary.

The typical pattern for Map B was that North district rates were higher than provincial rates while South district rates were lower due, possibly, to harsher climatic conditions and/or greater travel distances in the North districts. The typical Map C pattern was with Rural rates well above provincial rates, Metropolitan rates well below, and the Regional rates somewhere in between. This pattern was presumably related to the accessibility of care, and varying levels of care available within the regions of residence. There was no entirely typical pattern of regional variation for Map D.

Patient origin-destination studies from the district perspective revealed that most pediatric patients received care in hospitals located within their resident area. Of note, however, was the finding that, over time, an increasing proportion of Rural DAYS were being accumulated in Metropolitan hospitals. As the complexity/intensity of the disease category increased, so did the proportion of Rural and Regional patients who were treated outside their resident area, primarily in Metropolitan areas, and experienced longer lengths of stay. A similar pattern was noted for the six region (Map D) aggregate. The notable finding in the six region aggregate was that 27% of the Grande Prairie respiratory SEPS occurred in Calgary region hospitals (compared to only 15% in Edmonton region hospitals). This finding could not be fully explained.

Hospital perspective origin-destination studies found evidence to suggest that the University of Alberta Hospital and the Foothills Provincial General were the major referral centers for pediatric cases in Alberta between 1971 and 1980/81. These Referral hospitals committed 44% of their DAYS to children from other areas while other Metropolitan hospitals committed only 24% of their DAYS to other areas. Referral, Metropolitan, and Regional hospitals had all increased their commitments to Rural children over the years, but only the Regional hospital commitments rose steadily over time. The six region aggregate served primarily to reinforce the findings of the district perspective analysis of the six regions.

The analysis of utilization by levels of care determined 8% (44,916 DAYS) of the pediatric DAYS for 1980/81 could be attributed to tertiary level care in Alberta. This figure was then converted to bed requirements. Assuming an 85% occupancy level, 145 tertiary care pediatric beds were "required" in Alberta during 1980/81.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The preceding chapters present, in detail, the background, analytical components and the findings relevant to this investigation of pediatric service utilization in Alberta's acute care hospitals. This final chapter provides an overview and synopsis of the investigation and its findings. In addition, conclusions arising from the investigation are presented and recommendations for further research are offered.

5.1 Summary

Over the last two decades a number of social, medical and technological changes have influenced the delivery and utilization of acute pediatric care services. In the early nineteen eighties, as compared to the early sixties, the field of acute pediatric services delivered care to a smaller proportion of the pediatric population, encountered more complex cases, supported more highly trained pediatric specialists and subspecialists, and tended to be more concerned for the mental health of hospitalized children. Given these changes, the health service system is challenged to reconcile the new needs/demands with existing modes of care delivery. In order to achieve such a reconciliation, substantial information is required: the pediatric population, its current level of service use and trends over time, geographic variations in service use, movements to care centers, and the intensity/complexity of services used. Such a pediatric-specific information base was ostensibly lacking for the province of Alberta. These planning information needs constituted the impetus for this investigation and consequently shaped the objectives for the exploratory analysis. In addition, a review of past and present pediatric service utilization patterns in Alberta was expected to be of value to planners and administrators in an assessment of the feasibility of regionalizing pediatric hospital services in Alberta and to aid planning for cost effective and efficient allocation of resources--especially for tertiary level care.

A selected review of the literature was conducted in order to establish a theoretical foundation and an appropriate empirical approach to the research task. An overview of the determinants of need, demand, supply, and utilization of health services provided some insight into their complex, interactive relationships. As no model of pediatric utilization could be located in the literature, a conceptual framework was developed for the purposes of this investigation. It was based on a synthesis and interpretation of the existing literature regarding generic and pediatric utilization. In addition to this framework, the overview brought to light the difficulties inherent in determining need, in regulating demand, and in achieving equitable distribution or supply of specific health care resources. An examination of classification methodologies was undertaken to review data reduction techniques which would be useful in analysing large volumes of raw data. Finally, factors influencing patient movement and methodologies for examining patient origin-destination patterns were reviewed in regards to their relevance to an investigation of province wide utilization patterns.

The primary methodological strategy was to conduct the research from a descriptive, rather than an inferential perspective. Secondary strategies included: viewing utilization over time through the use of retrospective, rather than prospective, longitudinal data; examining utilization on a per-capita basis through the use of population-based utilization rates; and qualitatively differentiating utilization relative to intensity/complexity through the use of levels of care categories.

The data analyses were divided into five steps which corresponded with the investigational objectives. The first three steps examined patterns of pediatric utilization in Alberta from provincial, district, and regional levels of aggregation. These initial analyses were designed to explore patterns of hospital-use by children in relation to three major determinants of utilization: disease category or diagnosis, time (a proxy for changing patterns of practice and technology), and location of residence. In the fourth step, patterns of patient movement were examined from both a community-based and a provider-based perspective. This analysis explored patterns of hospital use in relation to three other determinants of hospital use; referral patterns, levels of care available, and intensity/complexity of illness. The fifth and final step was to use the patterns of patient movement to estimate the proportion of utilization which could be attributed to tertiary level care.

5.2 Findings

The principal findings arising from this investigation of utilization of acute hospital pediatric services are outlined below.

1) The review of literature regarding determinants of utilization failed to uncover a comprehensive theory or model of pediatric utilization or of utilization in a more general sense. Only a small portion of the literature regarding utilization determinants dealt specifically with pediatric services; while an even smaller portion dealt with pediatric acute care services in hospitals.

2) Pediatric utilization of Alberta hospital services, as measured by SEP rates and DAY rates, was shown to be declining over the study period. The rate for total patient-days dropped by more than 40% between 1971 and 1980/81. This decline was consistent with the Canadian pediatric experience and with the trend to declining utilization rates for the population as a whole. This pattern of decline was generally reflected in most of the disease-specific rates examined. The notable exception was a 130% increase in the DAY rate for perinatal disorders between 1971 and 1980/81.

3) The 1978 Albertan DAY rate for all diagnoses combined was 23% higher than the corresponding Canadian rate. The Albertan SEP rate was higher by 26%. Consequently, the Albertan ALOS was shorter than the Canadian counterpart. This pattern was also reflected in most of the diagnostic-specific rates, particularly for respiratory related diagnoses.

4) The Albertan 1979/80 DAY rate for all diagnoses combined was nearly double the corresponding rate for the United States. Alberta's diagnostic-specific rates were also typically much higher than the U.S. rates. This was also true for SEP rates and ALOSs.

5) Geographic patterns of pediatric utilization were relatively stable over time. Typical patterns of the four geographic aggregations included:

   a. Metro-Edmonton rates were generally higher, by varying degrees, than the Metro-Calgary rates.

   b. North Alberta rates were higher than South Alberta rates.

   c. Metropolitan area rates were relativaly low; Rural area rates were higher, and Regional rates were somewhere in between (particularly for SEP rates).

   d. No consistent pattern among the six regions emerged. However, Calgary often had the lowest rates while Grande Prairie often had the highest rates.

6) Most children received pediatric care within their area of residence but the tendency to seek care outside the area of residence was stronger for diagnoses which required specialized care.

7) Rural children, seeking care beyond their area of residence, tended to bypass secondary care centers, regardless of the diagnosis, and traveled directly to Metropolitan tertiary centers. In fact, during the study period, Rural children contributed an increasing proportion of their DAYS to Metropolitan hospitals. The same was true, to a lesser degree, for Regional children.

8) Over the study period, only 57% of Grande Prairie region children remained in their own region for all

types of pediatric care in hospitals. This relevance index was sensitive to the type of illness involved in that 58% of respiratory SEPS, 62% of trauma SEPS, and only 28% of congenital SEPS for Grande Prairie children occurred in the Grande Prairie region.

9) The University of Alberta Hospital committed 50% of its pediatric DAYS to children living beyond Edmonton and its immediately surrounding areas. This proportion was considerably higher than the corresponding commitments of the Royal Alexandra Hospital (22%) and the Misericordia (13%).

10) The Foothills Provincial General Hospital and the Alberta Children's Hospital both committed 24% of their pediatric DAYS to children living outside the Calgary district. The Foothills Hospital committed a substantially larger proportion of DAYS to "referred" children as the level of disease intensity/complexity increased. However, the Alberta Children's Hospital commitment to "referred" children was heavily weighted by primary level (respiratory) and secondary level (trauma) diseases.

11) Metropolitan and Regional hospitals increased their commitments to Rural children over the study period. This trend was magnified by increasing disease complexity/intensity.

12) Hospitals in the Calgary region had a relatively large secondary commitment to Grande Prairie. This level of commitment was greatest for respiratory diagnoses.

13) Using 1980/81 patient flow data it was estimated that, of a total of 304,000 DAYS; 45,000 DAYS could be attributed to tertiary level care, 87,000 DAYS to secondary level care, and 172,000 DAYS to primary level care. In terms of DAYS per 1000 children-year, the apportionment would be; 80 DAYS/1000, 155 DAYS/1000, and 308 DAYS/1000 for tertiary, secondary, and primary levels of care respectively.

14) The 45,000 tertiary level DAYS were estimated to represent 145 tertiary care pediatric bed equivalents, assuming an occupancy level of 85%. Thus, in 1980/81, Alberta used 145 pediatric beds for tertiary level care.

5.3 Conclusions

The conclusions arising from this study are presented below. These conclusions are only relevant to Alberta pediatric utilization within the time-frame of this investigation.

1) The dearth of literature specific to pediatric utilization, coupled with the lack of consensus in the literature regarding general utilization, has

precluded any comprehensive, universally accepted, understanding of the processes and determinants which might explain pediatric utilization of acute care hospitals.

2) The trends in pediatric utilization rates over the study period suggest some areas of rapidly changing need/demand. The dramatic increase in rates for perinatal disorders, for example, suggests that hospital pediatric services were being increasingly expected to cope with such a new and relatively complex area of service delivery. At the same time, use of the traditional pediatric services, for tonsillitis for example, is rapidly declining. Thus, pediatric services organized as little as ten years ago would be faced with responding to such changes in need/demand.

3) Alberta's apparently high pediatric DAY rates, as compared to national rates, seem to be a function of greater service volume rather than extended lengths of stay. Compared to U.S. pediatric utilization measures, Albertan children experience higher volumes of service and longer lengths of stay. Such differences could be related to need factors such as harsher climatic conditions or to supply factors such as wider distribution of pediatric service resources. Planners will need to carefully evaluate, any

proposals for increasing pediatric bed supplies in view of the accretionary relationship between resource-supply and utilization.

4) The relatively high utilization rates associated with Metro-Edmonton and North Alberta could be due to need, demand or supply factors, or a combination of all three. Further research would be required to identify the reasons for such differences. It appeared, however, that the higher rates for North Alberta were at least partially due to higher rates for respiratory related conditions. By implication then, higher rates in North Alberta likely represented higher service volume but not necessarily greater need/demand for resources to handle relatively complex conditions.

5) It appeared that areas with a full spectrum of service--tertiary, secondary, and primary care--experienced lower utilization rates (in SEPS and DAYS) than did the areas with only a partial spectrum of service. For a given diagnosis, it appeared that a Metropolitan child would be less likely to be admitted to hospital than his Rural counterpart. Such patterns of use suggested that the availability of a broad spectrum of pediatric services might reduce hospital utilization, likely by virtue of alternative avenues of care.

6) Several findings suggest that a natural "regionalization" of pediatric services is occurring. First is the tendency to seek care beyond the area of residence as diagnostic intensity/complexity increases. Second is the tendency, over time, for an increasing proportion of Regional and Rural children's DAYS to be accumulated in Metropolitan hospitals.

Given the apparent trend for pediatric hospitalizations to be due to increasingly complex diagnosis, it would seem prudent to consider developing, encouraging, or supporting the natural tendency towards regionalization.

7) The relatively low relevance indices for the Grande Prairie region suggest that pediatric hospital services in Grande Prairie do not necessarily satisfy the need/demands for regional referrals or secondary level care.

8) Based on commitment indices, it appeared that the University of Alberta Hospital and the Foothills Provincial General Hospital functioned as the major pediatric tertiary referral centers in Edmonton and Calgary respectivaly. The Alberta Children's Hospital did not appear to function in a comparable manner.

9) The tendency, over the study period, for Metropolitan and Regional hospitals to commit an increasing proportion of their resources to Rural children suggests that the "natural" regionalization of pediatric care may be strengthening over time.

10) The unexpectedly high commitment index for Calgary region hospitals to Grande Prairie region children was apparently related to the Alberta Children's Hospital and its tendency to commit a relatively large number of respiratory DAYS to children beyond the Calgary area.

11) The estimate of 145 tertiary level care pediatric beds (for 1980/81) seems plausible and appropriate. Validation of this estimate through other research efforts would, of course, be advisable. It does appear, however, that such an estimate, perhaps coupled with time series analyses of similar "need" levels in the future, could be of value to planners.

5.4 Recommendations

The following recommendations arise from the findings and conclusions of this investigation. Some recommendations address needs for further research into pediatric utilization patterns.

1) Because pediatric utilization patterns presently demonstrate a regionalized configuration, and because

this regionalization seems to be intensifying over time, it would seem appropriate for the provincial government to formalize these patterns. Definitive policies for regionalization of pediatric services would potentially streamline the pediatric care delivery and minimize the unnecessary duplication of costly services.

2) Should a policy of regionalization be adopted, existing trends in resource utilization could be exploited. In this regard, the University of Alberta Hospital in Edmonton and the Foothills Hospital in Calgary could continue functioning as the major tertiary referral centers for pediatric care in the province. It must be noted, however, that significant changes in pediatric services delivery occurred in Alberta after the end of the study period (March, 1981). These changes included the opening of intensive care beds in the Alberta Children's Hospital in early 1982. Such changes likely altered patterns of pediatric utilization and would, therefore, have to be taken into consideration.

3) The simple addition of pediatric beds to the Alberta hospital environment must be carefully considered, and perhaps discouraged, in view of Alberta's apparently high rates of utilization for pediatric acute care services as compared to Canadian and

American pediatric rates. However, in the absence of norms or "standards" for pediatric utilization rates, it is difficult to identify rates of utilization as high, low, or appropriate.

4) In planning the future configuration of pediatric, acute care services in Alberta, it would be advisable to incorporate the concept of varying levels of care. Estimating bed requirements by levels of care, for example, could facilitate more effective cost estimates and more efficient planning for support resources.

5) The investigation of pediatric origin-destination patterns, and the associated estimates of utilization by levels of care should be updated with more recent data. Of particular importance would be the impact of the new services provided by the Alberta Children's Hospital.

6) It would be valuable to study existing pediatric bed utilization to determine how many could be considered tertiary care beds. Toll's (1982) Bed Utilization Level Profile (BULP) methodology, would be useful in this regard.

7) A recommended modification/extension of this study would be to incorporate the concept of diagnostic related groups (DRGs) into an investigation of

utilization by levels of care. The DRG's would provide a more accepted and perhaps valid representation of disease intensity/complexity than did the composite diagnostic categories developed for this investigation.

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APPENDIX A

Population Adjustments

Appendix A.1

Weighted Sum Method for Age-Sex Adjustments[1]

$$N._j = \sum_k W_k P_{kj}$$

Where $N._j$ represents the age-sex adjusted number of residents in district $_j$

P_{kj} represents the sum of the number of residents in the age-sex group k in district $_j$

W_k represents a weight based on the relative per-capita resource requirement of the age-sex group k compared to the per-capita resource requirement of the total population.

The basic concept is that the age-sex adjusted population, or service population, is intended to represent the summation ($\sum_k$) of comparable person units ($W_k P_{kj}$) within a given study area, such as an hospital district ($_j$). With regard to utilization, or any disease risk, not all age and sex groups could be considered comparable. It would not seem reasonable to compare the utilization patterns of two districts if one had 80% of the population over age 65 while the other had 80% of the population between 35 and 45 years of age. Through the weighted sum method, a population figure is derived which represents comparable person units rather than actual persons. To differentiate this new figure from the crude population (P_{kj}) figures, it is referred to as the service population (N_{ij}) according to the definition outlined by Bay and Nestman (1980).

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[1] Source: Bay, K. and Nestman, L. A hospital service population model and its application. International Journal of Health Services, 1980, 10(4), 677-695.

In the weighted sum method, a weight (W_k) or a balancing factor, is applied to the district population within each age-sex category (P_{kj}). The weight represents some proportion of a measure (W) which a given age-sex category contributes to the whole. Usually, W is the ratio of an age-sex specific utilization rate to the total utilization rate. (Table A.2 presents W_k used for this investigation).

$$Wk = \frac{Dk.}{Pk.} / \frac{D..}{P..}$$

where $D_{k.}$ = utilization generated by the k^{th} age-sex group
$Pk.$ = number of people in the k^{th} age-sex group
$D..$ = total resources used in study area
$P..$ = total number of people in the study area

Thus $$N._j = \sum \left(\frac{D_{k.}\ P..}{D..\ Pk.}\right) \left(Pk_j \right)$$

AND $\sum N._j$ is the sum of all age-sex adjusted district populations which yields the age-sex adjusted population for the entire study area. (N..)

Table A.2

Age-Sex Adjusting Weights[1]

Age Group	Sex Males	 Females
under 1[2]	5.09	4.09
1 - 4	1.43	1.13
5 - 9	0.64	0.53
10 - 14	0.54	0.53

[1] Weights apply to W_k in age-sex adjustment formula outlined in Appendix 3.1.

[2] Excluding newborns.

Appendix A.3

Procedure for Exponential Population Projections

1. Census data were obtained for census years 1971, 1976, and 1981.
2. District service populations were derived from age-sex adjustments of district census populations (see Appendix A.1.
3. Assumed an unique yet constant yearly rate of increase for both census and service populations within each district.
4. Calculated annual rate of population increase (or decrease):

$$R = \mathrm{Exp}\ (\mathrm{In}\ (P_2/P_1))/n$$

where R = rate

P_1 = population (service or census) for base year

P_2 = population for boundary year

In = natural logarithm

Exp = exponent

n = number of years (units) of total increase

5. Calculated estimate populations for intercensal years for each district using a compounding method:

$P_{72} = P_{71} \times R_1$ $\quad$ $P_{77} = P_{76} \times R_2$

$P_{73} = P_{72} \times R_1$ $\quad$ $P_{78} = P_{77} \times R_2$

$P_{74} = P_{73} \times R_1$ $\quad$ $P_{79} = P_{78} \times R_2$

$P_{75} = P_{74} \times R_1$ $\quad$ $P_{80} = P_{79} \times R_2$

APPENDIX B

Disease Codes and Diagnostic Categories

Appendix B.1

Detailed Listing of Diagnostic Category Codes

Study Code	Diagnostic Category	H-ICDA Codes	H-ICDA-2 Codes	ICD-9-CM Codes
01	Intestinal Infections, Enteritis & Colitis	001.0 - 009.9 561.0 - 561.9 563.0 - 563.9	001.0 - 009.9 561.0 - 561.9 563.0 - 563.9 782.1	001.0 - 009.9 555.0 - 556.9 558.0 - 558.9
02	Strabismus	373.0 - 373.9	373.0 - 373.9	378.0 - 378.9
03	Otitis Media & Eustachian Tube Disorders	381.0 - 381.9	381.0 - 381.9 384.2	381.0 - 382.9
04	Acute Respiratory Infections & Influenza	460.0 - 465.9 470.0 - 470.9 489.0 - 489.9	460.0 - 465.9 470.0 - 470.9 489.0 - 489.9	460.0 - 466.9 487.0 - 487.9
05	Pneumonia	480.0 - 486.9	480.0 - 486.9	480.0 - 486.9
06	Asthma & Bronchitis	490.0 - 491.9 493.0 - 493.9	490.0 - 491.9 493.0 - 493.9	490.0 - 491.9 493.0 - 493.9
07	Hypertrophy of Tonsils	500.0 - 500.9	500.0 - 500.9	474.0 - 474.9
08	Abdominal Hernias	550.0 - 553.9	550.0 - 553.9	550.0 - 553.9

Appendix B.1
(cont'd)

Study Code	Diagnostic Category	H-ICDA Codes	H-ICDA-2 Codes	ICD-9-CM Codes
09	Congenital Anomalies of Heart & Great Vessels	746.0 - 747.4	744.0 - 747.3	745.0 - 747.4
10	Congenital Anomalies of Other Structures	740.0 - 745.9 747.5 - 759.9	740.0 - 743.9 747.4 - 759.9	740.0 - 744.9 747.5 - 759.9
11	Disorders of the Perinatal Period	772.0 - 778.9	760.0 - 768.9	764.0 - 779.9
12	Skull Fractures & Intracranial Injury	800.0 - 803.9 850.0 - 854.9	800.0 - 803.9 850.0 - 854.9	800.0 - 804.9 850.0 - 854.9
13	Other Fractures	805.0 - 829.9	805.0 - 829.9	805.0 - 829.9
14	Lacerations & Open Wounds	870.0 - 899.9	870.0 - 899.9	870.0 - 899.9
15	Burns	940.0 - 949.9	940.0 - 949.9	940.0 - 949.9
16	Poisonings	960.0 - 989.9	960.0 - 989.9	960.0 - 989.9

Appendix B.2

Diagnostic Category Titles and Abbreviations

Primary Categories

01	Intestinal Infections	Intest
02	Strabismus	Strab
03	Otitis Media	Otitis
04	Acute Respiratory Infections and Influenza	Ac.Resp
05	Pneumonia	Pneum
06	Asthma and Bronchitis	As/Br
07	Tonsillitis	Tonsil
08	Hernias (abdominal and Inguinal)	Hernia
09	Congenital Anomalies of the Heart	Cong.Ht
10	Congenital Anomalies (all others)	Cong.An
11	Disorders of the Perinatal Period	Peri
12	Skull Fractures	Skull#
13	Fractures (all others)	Other#
14	Lacerations	Lacer
15	Burns	Burn
16	Poisonings (medical and otherwise)	Poison
17	All other Diagnoses	---
18	All Diagnoses Combined	All

Combination Categories

04	Acute Respiratory Infections and Influenza	Resp	
05	Pneumonia		
06	As/Br		
09	Congenital Anomalies of the Heart	Cong.2	Cong
10	Congenital Anomalies (all others)		
11	Disorders of the Perinatal Period		
12	Skull Fractures	#/lacer	Trau
13	Fractures (all others)		
14	Lacerations		
15	Burns		

APPENDIX C

Formulae for Relevance and Commitment Indices

Appendix C

Calculation of Relevance and Commitment Indices[1]

1. Relevance Index (RI)

   A. RI of a given District to Hospital(s) located in that same district.

$$\frac{\text{number of District Residents separated from District Hospital(s)}}{\text{total number of District Residents separated from All Hospitals in the Province}} \times 100$$

   B. RI of a given District to Hospital(s) NOT located in that same district.

$$\frac{\text{number of District Residents separated from all Non-District Hospital(s)}}{\text{total number of District Residents separated from All Hospitals in the Province}} \times 100$$

2. Commitment Index (CI)

   A. CI of a given Hospital to the District in which it is located.

$$\frac{\text{number of District Residents Separated from the given District Hospital}}{\text{total number of Patients separated from the Hospital (residents from all over the province)}} \times 100$$

   B. CI of a given Hospital to all districts EXCLUDING the District in which it is located

$$\frac{\text{number of Patients separated from the given Hospital who lived Outside the District where the hospital was located}}{\text{total number of Patients separated from the given Hospital}} \times 100$$

---

[1] Source: MacDonald, 1982, p. 228.
Separations are used in the example calculations. Patient-day data can also be used, as can admission data.

APPENDIX D

Supplementary Tables for Diagnostic Specific Regional Analyses of Pediatric Utilization Rates

Appendix D

List of Tables

Table	Description	Page
D.1	Patient-day Rates for Aggregated Regional Areas in Alberta for Intestinal Infections	288
D.2	Patient-day Rates for Aggregated Regional Areas in Alberta for Otitis Media	289
D.3	Patient-day Rates for Aggregated Regional Areas in Alberta for Acute Respiratory Illnesses	290
D.4	Patient-day Rates for Aggregated Regional Areas in Alberta for Pneumonia	291
D.5	Patient-day Rates for Aggregated Regional Areas in Alberta for Asthma and Bronchitis	292
D.6	Patient-day Rates for Aggregated Regional Areas in Alberta for Tonsillitis	293
D.7	Patient-day Rates for Aggregated Regional Areas in Alberta for Congenital Anomalies	294
D.8	Patient-day Rates for Aggregated Regional Areas in Alberta for Perinatal Disorders	295
D.9	Patient-day Rates for Aggregated Regional Areas in Alberta for Fractures and Lacerations	296
D.10	Patient-day Rates for Aggregated Regional Areas in Alberta for Burns	297

Table D.1

Patient-day Rates[1] for Aggregated Regional Areas in Alberta for Intestinal Infections

Area	1971	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	71-80/81
Alta	88.8	90.9	81.4	80.1	76.0	79.0	62.3	60.5	63.8	48.1	72.6
Met.Ed	58.7	61.2	56.9	57.5	50.4	50.7	42.7	47.9	43.4	32.1	50.3
Met.Ca	42.4	36.5	43.1	38.4	32.6	34.4	27.1	24.9	26.7	20.6	32.4
Nor	111.5	115.7	99.2	99.2	96.7	101.4	79.9	78.4	85.1	62.4	92.4
Sou	55.1	54.2	55.2	52.1	45.7	46.2	36.6	34.3	32.6	27.1	43.5
Metro	50.9	49.2	50.1	48.0	41.5	42.4	34.8	36.0	34.7	26.0	41.3
Reg	71.0	67.9	71.4	59.8	65.8	63.1	55.0	48.4	46.4	35.2	57.5
Rural	146.9	154.7	126.7	128.0	123.7	129.5	98.9	94.2	104.3	78.4	117.3
Edm	113.1	117.5	98.7	98.8	94.6	100.4	76.1	78.2	87.3	61.9	92.2
Calg	46.6	45.8	48.8	45.9	37.9	41.7	31.7	30.3	30.5	24.8	38.1
Gr.P.	123.7	113.4	97.6	110.3	144.4	132.9	143.2	94.0	83.9	83.8	111.7
Leth	107.0	101.0	96.1	96.7	84.2	76.1	67.0	53.9	41.9	36.5	75.3
Med.Ht	47.9	47.0	44.4	29.6	55.3	31.9	28.7	40.7	35.1	29.3	38.5
Rd.Dr.	81.5	98.6	99.3	89.0	83.5	86.5	73.0	66.2	61.2	52.4	77.8

[1] Rates represent the number of patient-days per 1000 children-year.

Table D.2

Patient-day Rates[1] for Aggregated Regional Areas in Alberta for Otitis Media

Area	1971	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	71-80/81
Alta	19.9	17.7	27.1	24.7	23.2	22.7	20.3	17.4	15.7	13.1	20.1
Met.Ed	3.1	5.8	8.8	9.8	10.1	10.6	8.3	9.3	6.4	6.7	7.9
Met.Ca	8.4	4.9	10.1	9.1	9.0	8.6	7.7	7.5	8.0	5.2	7.8
Nor	25.5	24.4	36.9	32.3	30.7	30.1	26.0	22.1	19.3	15.8	26.1
Sou	11.7	7.9	12.8	13.7	12.2	11.9	11.9	10.6	10.6	9.1	11.2
Metro	5.6	5.4	9.5	9.4	9.6	9.6	8.0	8.4	7.3	5.9	7.8
Reg	20.9	13.9	17.6	19.3	14.9	17.5	15.8	13.6	15.4	13.6	16.1
Rural	40.1	36.0	53.7	46.6	43.1	40.8	36.9	29.8	26.4	21.8	37.0
Edm	24.3	23.5	38.0	32.2	31.1	30.4	26.7	22.5	17.9	15.7	26.0
Calg	9.9	6.4	11.8	12.1	11.1	10.1	8.9	8.9	8.7	6.3	9.4
Gr.P.	55.6	42.6	45.5	52.9	32.7	38.4	28.7	31.7	49.8	22.1	39.5
Leth	20.9	15.0	17.9	19.5	16.8	19.3	24.2	17.3	18.2	21.4	19.1
Med.Ht	14.5	10.0	15.1	23.4	15.3	16.7	22.8	16.0	19.0	18.3	17.3
Rd.Dr.	18.9	20.7	18.4	18.1	23.5	21.6	15.8	12.0	12.7	12.4	17.2

[1] Rates represent the number of patient-days per 1000 children-year.

Table D.3

Patient-day Rates[1] for Aggregated Regional Areas in Alberta for Acute Respiratory Illnesses

Area	1971	1972	1973	1974	1975	1976	1977	1978	1979/80	1930/81	71-80/81
Alta	129.0	136.1	121.1	125.9	108.2	101.1	92.4	80.6	79.0	71.1	103.7
Met.Ed	56.9	64.7	56.1	63.2	57.0	58.6	52.7	41.1	40.4	34.6	52.6
Met.Ca	46.8	62.0	42.2	48.1	38.0	35.5	33.6	25.0	24.0	21.5	37.2
Nor	161.9	164.9	153.8	157.4	134.6	128.4	115.4	104.4	102.5	91.2	130.6
Sou	80.0	93.6	73.0	79.6	69.5	61.2	58.8	46.0	44.6	41.8	64.2
Metro	52.1	63.4	49.3	55.7	47.5	46.9	42.9	32.8	31.9	27.7	44.9
Reg	132.2	140.9	110.4	115.8	88.2	89.8	86.6	68.3	63.6	62.5	93.8
Rural	238.0	237.3	222.2	222.6	192.6	173.2	156.7	143.8	141.3	126.8	183.1
Edm	155.5	159.5	150.7	152.8	130.5	124.2	111.3	101.7	102.0	91.1	127.2
Calg	65.1	78.2	60.3	65.3	57.5	54.2	47.7	38.1	36.1	32.1	53.0
Gr.P.	230.3	218.8	188.6	202.1	188.6	217.3	171.3	157.1	118.4	93.3	175.0
Leth	150.9	157.2	129.7	140.1	125.1	90.5	99.3	66.0	57.5	55.0	106.1
Med.Ht	99.6	125.9	89.9	109.4	83.5	69.8	83.4	74.9	103.9	104.4	94.1
Rd.Dr.	186.9	191.1	162.4	175.6	141.5	115.2	127.3	104.5	99.4	99.0	138.6

[1] Rates represent the number of patient-days per 1000 children-year.

Table D.4

Patient-day Rates[1] for Aggregated Regional Areas in Alberta for Pneumonia

Area	1971	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	71-80/81
Alta	135.9	156.3	102.5	128.5	122.2	105.3	94.0	74.0	56.9	51.2	101.5
Met.Ed	96.3	113.5	66.1	77.8	70.6	50.2	47.8	36.0	31.1	31.3	62.7
Met.Ca	56.4	61.1	37.8	48.9	46.2	39.2	27.6	23.0	17.6	17.4	37.0
Nor	180.8	209.7	140.8	175.2	166.0	143.8	131.3	104.0	79.2	69.0	138.4
Sou	69.2	77.2	46.1	60.0	58.1	48.9	39.6	30.2	24.5	25.0	47.2
Metro	77.2	88.1	52.2	63.5	58.4	44.6	37.5	29.3	24.1	24.0	49.7
Reg	106.9	104.5	61.4	71.5	77.8	62.2	66.0	57.5	46.8	33.5	67.2
Rural	226.1	264.0	181.0	229.3	216.5	193.0	172.5	134.2	100.4	88.9	177.4
Edm	177.1	208.4	138.5	173.1	165.1	139.5	129.9	101.0	79.8	71.5	137.1
Calg	64.5	75.7	43.1	59.0	56.1	47.1	35.5	27.7	21.4	21.6	44.6
Gr.P.	361.0	404.6	302.4	399.7	304.4	329.4	258.6	264.6	143.9	97.8	278.8
Leth	95.5	99.3	69.5	68.6	79.4	59.8	56.0	44.1	37.6	42.4	64.6
Med.Ht	61.7	37.3	23.2	55.3	37.1	40.9	39.9	21.8	29.5	21.8	36.1
Rd.Dr.	112.7	104.7	65.6	54.8	80.6	68.9	65.7	32.7	31.6	27.9	63.1

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[1] Rates represent the number of patient-days per 1000 children-year.

Table D.5

Patient-day Rates[1] for Aggregated Regional Areas in Alberta
for Asthma and Bronchitis

Area	1971	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	71-80/81
Alta	46.0	58.8	43.4	42.1	46.8	44.3	43.3	38.0	32.8	32.9	42.6
Met.Ed	25.2	34.4	27.5	25.8	26.8	26.1	21.7	22.9	19.7	17.3	24.9
Met.Ca	26.6	42.4	28.6	28.3	24.3	25.0	19.2	20.5	16.5	19.0	24.9
Nor	52.9	65.6	50.2	48.7	56.4	54.0	55.6	47.4	39.8	38.0	50.6
Sou	35.8	48.8	33.6	32.4	32.9	30.2	25.4	24.2	22.5	25.4	30.9
Metro	25.9	38.8	28.1	27.1	25.6	25.5	20.4	21.7	18.1	18.2	24.9
Reg	53.7	58.7	51.3	44.4	51.8	36.1	30.9	30.8	28.6	37.7	41.7
Rural	73.1	87.1	62.8	61.7	73.6	70.3	75.5	60.2	52.1	49.8	66.1
Edm	52.6	63.5	48.2	47.3	56.0	55.2	54.4	47.6	39.4	37.7	50.0
Calg	32.0	48.3	31.3	31.0	28.7	29.0	23.9	22.0	20.3	22.0	28.6
Gr.P.	48.6	96.7	73.1	65.5	50.7	38.0	52.8	55.1	61.3	56.9	59.5
Leth	42.4	48.7	53.2	39.2	47.3	30.3	26.4	32.0	33.7	42.3	39.4
Med.Ht	72.5	48.2	16.0	34.4	51.8	44.0	43.5	31.7	21.6	26.9	38.3
Rd.Dr.	58.8	71.3	54.0	51.2	61.5	49.8	65.5	39.6	30.6	30.4	50.5

[1] Rates represent the number of patient-days per 1000 children-year.

Table D.6

Patient-day Rates[1] for Aggregated Regional Areas in Alberta
for Tonsillitis

Area	1971	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	71-80/81
Alta	55.9	44.8	35.3	33.4	35.8	29.9	27.6	25.6	22.5	19.5	32.7
Met.Ed	44.7	35.6	27.8	28.7	32.8	25.7	22.6	21.0	18.4	17.1	27.6
Met.Ca	47.8	38.1	33.7	32.6	29.2	24.7	21.5	21.7	20.9	17.2	28.5
Nor	57.5	46.3	35.3	32.4	37.2	30.5	27.5	25.2	21.4	19.3	32.9
Sou	53.7	42.7	35.3	34.8	33.6	29.1	27.8	26.2	24.2	19.9	32.4
Metro	46.2	36.8	30.7	30.6	31.0	25.2	22.0	21.4	19.7	17.2	28.0
Reg	63.4	45.3	40.5	36.7	37.0	32.5	33.3	27.2	21.6	18.6	34.7
Rural	68.1	56.0	40.4	36.3	41.7	35.4	33.3	30.5	26.3	22.6	38.4
Edm	54.7	45.6	34.5	32.5	37.1	30.2	27.3	25.7	21.9	20.4	32.8
Calg	48.3	39.9	33.1	32.3	31.1	26.8	23.9	22.6	21.5	17.3	29.4
Gr.P.	112.2	68.9	43.0	31.0	36.9	27.2	23.5	24.9	18.9	13.6	38.2
Leth	79.2	55.4	44.9	44.4	43.5	37.9	41.0	35.7	32.6	27.0	43.8
Med.Ht	49.3	38.5	30.0	33.7	31.0	26.7	32.2	31.4	29.7	25.3	32.3
Rd.Dr.	62.1	45.3	43.7	36.7	43.0	40.2	38.1	29.5	22.6	17.6	37.2

[1] Rates represent the number of patient-days per 1000 children-year.

Table D.7

Patient-day Rates[1] for Aggregated Regional Areas in Alberta for Congenital Anomalies

Area	1971	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	71-80/81
Alta	54.4	58.4	41.2	39.0	31.6	36.1	37.0	35.9	28.8	29.8	39.5
Met.Ed	54.3	49.8	37.1	32.2	34.3	32.6	34.1	33.0	29.0	29.4	36.8
Met.Ca	58.2	71.8	52.1	42.4	39.9	32.9	33.4	24.6	25.7	26.2	40.3
Nor	52.9	51.2	37.4	35.9	36.1	35.2	38.6	40.8	30.2	30.6	38.7
Sou	56.7	69.1	46.7	43.5	39.8	37.3	34.6	28.6	26.9	27.9	40.7
Metro	56.2	60.5	44.4	37.3	37.1	32.7	33.8	28.7	27.3	27.7	38.6
Reg	61.4	58.5	38.6	39.4	41.4	43.3	47.0	33.9	32.0	31.6	42.1
Rural	50.3	55.6	37.2	41.2	37.4	38.7	38.7	45.3	29.9	31.2	40.2
Edm	53.3	51.0	37.5	25.0	35.6	34.3	37.4	41.4	28.3	30.8	38.4
Calg	54.6	69.4	47.5	39.7	38.2	32.7	33.5	25.5	25.1	27.1	39.0
Gr.P.	41.7	41.6	38.5	23.9	37.9	51.3	31.9	40.4	29.8	30.1	36.4
Leth	56.7	70.3	48.9	63.1	41.2	49.9	35.7	41.8	34.5	30.2	46.9
Med.Ht	79.9	54.0	28.7	48.2	54.6	69.9	50.2	31.9	29.4	30.8	46.8
Rd.Dr.	58.7	64.2	37.1	50.8	41.4	34.4	52.2	37.1	38.9	29.7	44.1

[1] Rates represent the number of patient-days per 1000 children-year.

Table D.8

Patient-day Rates[1] for Aggregated Regional Areas in Alberta for Perinatal Disorders

Area	1971	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	71-80/81
Alta	6.9	9.4	9.8	16.6	22.7	20.1	19.3	22.4	13.9	16.0	15.7
Met.Ed	1.3	2.3	3.2	10.2	15.5	17.8	16.5	14.2	7.9	13.8	10.1
Met.Ca	2.3	6.4	4.7	11.2	18.6	11.8	11.6	18.6	11.0	16.3	11.3
Nor	6.6	9.2	10.9	17.9	22.6	23.6	22.7	22.8	12.7	15.6	16.5
Sou	7.3	9.7	8.2	14.6	22.8	15.0	14.4	21.8	15.5	16.6	14.7
Metro	1.8	4.3	3.9	10.7	17.1	14.7	14.0	16.5	9.5	15.1	10.7
Reg	5.9	9.7	10.2	15.6	25.7	16.7	28.1	29.0	21.7	20.5	18.8
Rural	14.5	16.5	17.8	24.8	29.3	27.7	24.0	28.1	17.4	16.0	21.6
Edm	5.6	6.7	10.2	17.8	21.8	23.1	20.5	21.8	11.6	14.4	15.3
Calg	6.1	9.7	6.5	12.5	21.9	14.8	13.8	20.4	13.2	16.2	13.6
Gr.P.	9.2	41.9	17.7	20.5	50.0	35.5	38.9	36.5	16.8	12.2	27.7
Leth	11.3	13.8	18.7	30.6	19.2	20.5	15.0	27.7	18.1	13.9	18.9
Med.Ht	8.6	0.4	2.8	4.5	48.2	3.5	17.7	12.5	35.0	18.9	15.8
Rd.Dr.	17.8	15.3	14.9	16.7	13.5	20.9	34.3	29.0	23.1	33.0	22.2

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[1] Rates represent the number of patient-days per 1000 children-year.

Table D.9

Patient-day Rates[1] for Aggregated Regional Areas in Alberta for Fractures and Lacerations

Area	1971	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	71-80/81
Alta	54.6	56.8	51.7	49.6	45.4	50.8	45.6	39.0	39.6	33.9	46.4
Mat.Ed	38.1	41.4	39.6	34.3	34.7	39.2	39.3	37.5	29.6	26.0	36.0
Met.Ca	46.6	51.7	41.9	44.8	39.7	45.3	33.9	27.0	36.8	31.1	39.6
Nor	57.6	58.8	53.1	48.9	47.5	50.5	48.1	44.6	40.0	33.4	48.0
Sou	50.2	54.0	49.7	50.6	42.3	51.3	41.8	30.9	39.0	34.7	44.2
Metro	42.2	46.4	40.7	39.5	37.2	42.3	36.6	32.1	33.3	28.7	37.8
Reg	55.9	56.5	45.9	72.3	47.3	48.6	53.2	29.4	32.4	30.4	46.6
Rural	71.4	71.6	68.1	57.9	55.6	62.3	55.2	50.1	49.2	41.2	57.7
Edm	54.3	57.0	53.9	44.9	45.7	49.2	47.1	44.7	39.4	32.2	46.7
Calg	48.3	53.3	47.3	46.2	43.0	51.8	38.1	28.9	37.1	33.7	42.5
Gr.P.	60.8	54.4	42.5	84.2	51.4	49.9	39.4	30.7	28.3	31.4	46.3
Leth	46.0	51.4	63.4	65.9	45.5	49.9	61.1	37.9	48.7	41.8	51.0
Med.Ht	70.5	64.9	43.8	61.2	27.3	46.0	42.3	21.7	37.9	28.4	43.3
Rd.Dr.	96.0	80.5	51.2	70.9	60.8	64.8	63.5	59.0	53.8	36.5	64.2

[1] Rates represent the number of patient-days per 1000 children-year.

Table D.10

Patient-day Rates[1] for Aggregated Regional Areas in Alberta
for Burns

Area	1971	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	71-80/81
Alta	13.1	13.8	14.9	13.5	13.8	13.3	12.1	10.2	9.6	9.3	12.3
Met.Ed	9.1	9.6	10.0	8.6	11.0	9.5	9.4	7.2	9.6	6.4	9.0
Met.Ca	7.4	5.7	9.6	7.9	6.3	10.0	4.9	4.4	5.0	4.5	6.5
Nor	15.3	17.6	17.6	14.8	17.1	14.9	15.3	12.7	11.6	11.2	14.7
Sou	9.9	8.2	10.9	11.5	8.8	11.0	7.5	6.5	5.7	6.3	8.7
Metro	8.3	7.7	9.8	8.3	8.6	9.8	7.1	5.8	7.2	5.4	7.8
Reg	10.9	9.7	13.0	12.6	13.1	13.3	9.8	11.6	8.6	5.4	10.8
Rural	20.5	23.2	22.5	20.6	20.7	17.8	19.1	15.4	12.8	14.7	18.5
Edm	15.5	17.7	17.0	13.9	16.9	15.1	15.6	12.1	11.5	10.4	14.5
Calg	8.7	7.5	10.2	10.7	7.7	10.1	7.2	5.0	6.3	5.5	7.8
Gr.P.	19.2	13.8	22.3	30.5	23.9	21.6	12.2	20.8	8.8	20.7	19.2
Leth	13.8	7.7	14.4	10.3	10.9	16.1	12.0	13.1	8.8	9.9	11.7
Med.Ht	15.6	17.1	11.5	19.1	18.5	11.3	1.3	4.5	7.8	9.3	11.2
Rd.Dr.	10.7	18.3	20.5	17.4	15.0	7.8	12.2	15.6	12.6	12.8	14.3

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[1] Rates represent the number of patient-days per 1000 children-year.

APPENDIX E

List of Titles and Abbreviations for Regional Analyses

Appendix E

Regional Analyses Area Titles and Abbreviations

Alberta	Alta
Metropolitan Edmonton	Met.Ed
Metropolitan Calgary	Met.Ca
North Alberta	Nor
South Alberta	Sou
Metropolitan Areas	Metro
Regional Center Areas	Reg
Rural Areas	Rural
Edmonton Region	Edm
Calgary Region	Calg
Grande Prairie Region	Gr.Pr
Lethbridge Region	Leth
Medicine Hat Region	Med.Ht
Red Deer Region	Rd.Dr

APPENDIX F

Supplementary Tables for Patient Origin-Destination Studies for Geographic Regions

Appendix F

List of Tables

Table	Description	Page
F.1	Relevance Indices (Patient-days) for Regional Patients in Their Own and Other Regional Hospitals	302
F.2	Relevance Indices (Patient-days) for Regional Patients in Their Own and Other Regional Hospitals for Composite Diagnostic Categories	303
F.3	Average Lengths of Stay in Regional Hospitals by Region of Patient Origin	304
F.4	Average Lengths of Stay in Regional Hospitals by Region of Patient Origin for Composite Diagnostic Categories	305

Table F.1

Relevance Indices[1] (Patient-days) for Regional Patients in Their Own[2] and Other Regional Hospitals

		Edm	Calg	Gr.Pr	Leth	Med.Ht	Rd.Dr.
DAYS %	Edm	99	0	0	0	0	1
	Calg	2	95	0	1	1	1
	Gr.Pr	26	25	49	0	0	0
	Leth	3	17	0	80	0	0
	Med.Ht	1	18	0	5	76	0
	Rd.Dr	14	6	0	0	0	80

[1] Indices calculated for all years combined and for all diagnoses combined.

[2] A patient's "own" hospital is located within the patient's region of residence.

Table F.2

Relevance Indices[1] (Patient-days) for Regional Patients in Their Own[2] and Other Regional Hospitals for Composite Diagnostic Categories

Region of Origin	Region of Destination Edm Resp	 Edm Trau	 Edm Cong	 Calg Resp	 Calg Trau	 Calg Cong	 Gr.Pr Resp	 Gr.Pr Trau	 Gr.Pr Cong	 Leth Resp	 Leth Trau	 Leth Cong	 Med.Ht Resp	 Med.Ht Trau	 Med.Ht Cong	 Rd.Dr Resp	 Rd.Dr Trau	 Rd.Dr Cong
DAYS %																		
Edm	99	98	99	0	1	1	0	0	0	0	0	0	0	0	0	1	1	1
Calg	3	1	2	95	95	95	0	0	0	1	1	1	0	1	1	1	2	1
Gr.Pr	13	31	81	35	13	2	52	56	17	0	0	0	0	0	0	0	0	0
Leth	2	2	5	10	14	49	0	0	0	88	84	46	0	0	0	0	0	0
Med.Ht	0	0	3	2	13	65	0	0	0	4	5	4	94	82	28	0	0	0
Rd.Dr	7	11	44	3	8	10	0	0	0	0	0	0	0	0	0	90	81	46

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[1] Indices are calculated for all years combined.

[2] A patient's "own" hospital is located within the patient's region of residence.

Table F.3

Average Lengths of Stay[1] in Regional Hospitals by Region of Patient Origin

		Patient Origin					
	Hosp	Edm	Calg	Gr.Pr	Leth	Med.Ht	Rd.Dr
ALOS							
	Edm	6.1	4.9	7.3	4.2	7.5	8.1
	Calg	5.2	5.5	7.4	10.3	14.1	6.7
	Gr.Pr	5.1	3.9	5.2	1.6	3.0	4.1
	Leth	3.8	4.6	3.1	4.5	4.9	4.2
	Med.Ht	3.7	4.0	1.7	3.9	3.8	2.3
	Rd.Dr	5.4	5.1	3.4	3.7	2.5	4.6

---

[1] Average Lengths of stay are calculated for all years combined and for all diagnoses combined.

Table F.4

Average Lengths of Stay[1] in Regional Hospitals by Region of Patient Origin for Composite Diagnostic Categories

Hosp	Patient Origin																	
	Edm			Calg			Gr.Pr			Leth			Med.Ht			Rd.Dr		
	Resp	Trau	Cong	Resp	Trau	Cong	Resp	Trau	Cong	Resp	Trau	Cong.	Resp	Trau	Cong	Resp	Trau	Cong
ALOS																		
Edm	6.7	5.4	9.2	4.4	3.4	10.3	6.3	6.4	11.8	4.0	2.6	11.0	3.1	1.8	11.9	5.6	8.3	12.3
Calg	4.1	4.1	7.4	5.4	5.4	9.9	9.0	4.7	6.2	6.6	8.2	18.1	6.3	13.0	16.0	5.5	7.7	11.5
Gr.Pr	5.6	6.7	7.5	4.5	3.8	0	6.3	4.4	6.0	1.5	1.5	0	3.0	0	0	4.8	1.5	0
Leth	3.6	3.3	2.3	5.3	4.9	6.8	2.8	0	0	5.2	4.9	7.1	5.6	5.1	6.7	2.7	10.4	11.0
Med.Ht	2.6	2.2	5.0	4.9	6.3	8.8	3.0	0	0	5.0	2.7	1.7	4.4	3.7	5.9	2.4	2.0	0
Rd.Dr	6.1	5.9	7.7	5.7	6.5	7.2	2.8	1.2	0	2.8	3.5	0	4.3	1.0	3.0	5.2	4.9	6.7

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[1] Average lengths of stay are calculated for all years combined.

APPENDIX G

List of Hospital Names and Abbreviations

Appendix G

Names and Abbreviations for Edmonton and Calgary Acute Care Hospitals

Edmonton	
University of Alberta Hospitals	UAH
Royal Alexandra Hospital	RAH
Misericordia Hospital	MIS
Edmonton General Hospital	EGH
Charles Camsell Hospital	CAM
Cross Cancer Institute	CRO
Calgary	
Foothills Provincial General Hospital	FTH
Alberta Hospital for Children	AHC
Calgary General Hospital	CAG
Holy Cross Hospital	HCH
Rockyview General Hospital	ROC
Salvation Army Grace Hospital	SAL

APPENDIX H

Tables of Estimates of Tertiary Bed Requirements by Varying Occupancy Rates

Table H

Estimates of Tertiary Care Bed Requirements in Alberta Based on Varying Occupancy Rates and the 1980/81 Utilization Data

Occupancy Rate	Tertiary Bed Estimate
65%	189
70%	176
75%	164
80%	154
85%	145
90%	137
95%	129